DOCUMENT RESUME

ED 068 270 SE 012 552

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TITLE	Report to UNESCO on Eleven Weeks as Consultant to the Governments of Kenya, Tanzania, Zambia and Malawi on Aspects of Biology Teaching, February to April, 1971.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France).
REPORT NO	ISBN-85837-006-9
PUB DATE	71
NOTE	147p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Biology; Change Agents; Curriculum Development; *Developing Nations; Educational Programs; *International Education; Secondary School Science
IDENTIFIERS	Kenya; Malawi; Tanzania; UNESCO; Zambia

ABSTRACT

This report describes the activities of a UNESCO consultant who visited Kenya, Tanzania, Zambia and Malawi for the purpose of assisting local education agencies in the Biology Teaching Pilot Project. The consultant's report briefly summarizes the status of the School Science Project (SSP) in these East African countries. Also listed are the attempts and activities that have been undertaken to write books, train teachers and evaluate the program. Recommendations for future action are given. (PS)

ED 060110

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Dept. Ref.: SC/RP

BOC. Ref.: SC 250.038
SC 250.038 -
Amendment No. 1

United Nations Educational
Scientific and Cultural Organization

Report to : Division of Science Teaching,
United Nations Educational Scientific and
Cultural Organization

on : Eleven weeks as Consultant to the Governments of Kenya, Tanzania, Zambia and Malawi on Aspects of Biology Teaching - February to April, 1971

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SE 012 552

ISBN 85837 006 9

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SECTION 1. Summary and Main Conclusions

1.1 In Kenya, the SSP Biology Programme has reached Form 3, and the textbook for Form 4 has been published under the supervision of the Kenyan Biology Panel. The teachers' guide for Book IV is being released on cyclostyled sheets in sections. Some discussions were held with the Panel on adding statements of objectives and lists of investigations.

1.2 Two problems in Kenya have been the difficulty of mounting in-service courses in regional centres and the difficulty of obtaining systematic feedback from the trial schools. Considerable time was spent in Kenya in giving prototype one-day in-service courses in regional centres to provide a model for future expansion of in-service activities. These courses were well received and well attended. A systematic study was also undertaken as a preliminary evaluation of the effectiveness of SSP Biology in Kenya. Similar studies were completed in Zambia and Malawi. These were undertaken mainly to train local people in appropriate methods of curriculum evaluation. Discussions were also held in Kenya, Zambia and Malawi on methods of obtaining effective feedback from schools.

1.3 In Tanzania, the Ministry of National Education requires reports on the effectiveness and suitability of SSP Science for Tanzanian pupils. Most of the time in Dar-es-Salaam was spent with Biology and Chemistry Panels in discussions on methods of obtaining summative evaluation data for these reports.

1.4 In Kenya and Malawi, teachers were given training in the setting of objective examination questions, testing for understanding rather than mere recall of knowledge. In Kenya, questions prepared by a teachers' workshop were used for a book of questions requested by the East African Examination Council.

1.5 In East Africa, the International Co-ordinator appointed to help with the final version of the books, has been unable to work effectively because of administrative difficulties that are fully discussed in SECTION 4. A co-ordination committee of three has been suggested as an alternative model - one representative from each of Kenya, Tanzania and Uganda.

1.6 In Zambia the Unesco Study Group is working to produce local editions of the Unesco Pilot Project Units as background reading for teachers. The group has so far made no direct contribution to curriculum construction for Zambian schools but has been most effective in establishing links between school biology, government departments concerned with biological problems and various biological institutions. Recommendations were made during this mission to bring the Study Group into closer contact with the new Curriculum Development Centre of the Ministry of Education.

1.7 The Curriculum Development Centre in Zambia has been founded to prepare new curricula for primary and secondary schools. This is an important institution worthy of the fullest support but does require more

personnel and also fellowships to train local people in curriculum methods. During this mission, a seminar was given to staff of the Centre on curriculum evaluation.

1.8 An important project in Zambia is the Secondary School Science Pilot Project (SSSPP). This programme consists of courses of physics, chemistry and biology in each of five schools. The courses are slight modifications of the Nuffield O-level programmes, and in general have been successful in the five trial schools in attaining their objectives. These objectives, however, do not necessarily fit Zambian education. Another problem is that the trial schools are not typical of secondary schools in Zambia and therefore SSSPP programmes have a poor chance of succeeding in average or below average secondary schools. It is recommended that the experiment be phased out but that the best of the programme be used in the development of new courses, perhaps in physical science and biology.

1.9 In Zambia, the Zambian Association for Science Education (ZASE) is very active. Recommendations were made to bring the work of the Association into close co-operation with the Curriculum Development Centre.

1.10 In Malawi, the Unesco Study Group has completed trialling Unesco Units 1 to 6 and 8 to 10 in Forms 1 and 2, and are now redeveloping these units for the 2nd form Junior Certificate Examination. The trials have been successful, but there is need for more systematic feedback to obtain information for the final version of the books. The Study Group in Malawi is very active and the work is undertaken in the main by local Malawian teachers who are producing materials of high quality.

1.11 An important achievement of this mission was the completion of evaluation studies of new biology curricula in Kenya, Malawi and Zambia (see SECTION 1.2 above). Results of these studies showed that the courses in Malawi and Kenya were popular with pupils and teachers, had appropriate objectives for the country concerned and had high probability of success if transferred from trial schools to all secondary schools. The SSP course in Kenya was about 25% too long and some sections were too difficult, but these problems would be taken into consideration during the final version. In Zambia, the SSSPP programme has a poor chance of success beyond the trial schools (see SECTION 1.8 above).

1.12 There is need for a sub-regional consultancy service to help various countries with preparation of final editions, with in-service courses and with evaluation studies.

1.13 In the more distant future, there is need for sub-regional "Centres for the Development of Learning Materials" that would produce prototype materials and train personnel for national study groups.

SECTION 2. Terms of Reference and their Interpretation

2.1 The terms of reference in the contract with Unesco were as follows:

"The consultant shall undertake a consultant mission of about 11 weeks duration to Kenya, Zambia, Malawi and Tanzania. He will provide assistance to the governments of these four countries in regard to the Biology Teaching Pilot Project. He will provide guidance in the writing of teachers' guides, the re-evaluation of biology textbooks for Forms 1, 2, 3 and 4 and the preparation of examinations in Biology.

Upon completion of his mission, he shall submit to Unesco a full report on the work accomplished, including his assessment of the situation and his recommendations for future improvement."

2.2 The terms of reference were interpreted in each country as follows:

i) Kenya (one month). The Kenyan Biology Panel, based at the Kenya Institute of Education, asked for assistance in the following areas: (a) organization of a workshop for panel members and local teachers to prepare sample questions in biology for the East African Examination Council, (b) assistance with an evaluation study of the effectiveness of SSP Biology books in Forms 1 to 3 in Kenyan Secondary Schools, (c) preparation of materials for and the mounting of a series of one-day in-service courses for biology teachers in regional centres to give orientation on the discovery approach to teaching and examining, (d) advice on preparation of the teachers' guide for Book IV SSP Biology. All these activities were successfully completed.

ii) Tanzania (three days). The Tanzanian SSP Biology Panel, together with the SSP Chemistry Panel, especially requested advice on examination procedures and on methods of obtaining a summative evaluation of their programmes. The three days in Tanzania were spent, therefore, in intensive discussions with Panel members and with the Ministry of National Education on these matters.

iii) Zambia (three weeks). In Zambia the Unesco booklets produced for the Biology Teaching Pilot Project have not been used as the basis of a new curriculum for Secondary Schools but are being re-developed as background enrichment for teachers and pupils. I was asked to examine the effectiveness of this approach. In addition, the Ministry of Education working with the Science Education Centre of the University of Zambia had initiated a Secondary School Science Pilot Project (SSSPP) based on Nuffield Science in five Zambian Secondary Schools. A request was forwarded through the Lusaka office of UNDP to evaluate the effectiveness of this experimental course in biology; to give talks and seminars at the University Science Education Centre, and to work with the staff of the new Curriculum Development Centre of the Ministry of Education on problems of curriculum evaluation. A number of activities arising from these requests was successfully completed.

iv) Malawi (three weeks). The Unesco booklets have been used in five trial schools in Malawi as the basis for a new course in biology for Forms 1 and 2 leading to the Junior Certificate Examination. The local Study Group requested, therefore, a preliminary evaluation of the effectiveness of the new course. In addition, a request was made for assistance with mounting a workshop for Unesco biology teachers to orient them towards the approach used in the Unesco booklets; to give some assistance with a new lay-out for the preparation of local editions of the books and the teachers' guides and to give some training in the techniques of examining and field teaching. In addition, I was asked to give lectures at the University of Malawi and to have talks with officials of the Ministry of Education and the Department of External Aid. These activities were successfully completed.

2.3 A summary of activities undertaken during this mission is presented as Appendix A. A list of personnel closely involved in the mission is given as Appendix B. A list of schools and institutions visited is given as Appendix C.

See Appendix A
See Appendix B
See Appendix C

SECTION 3. Present situation of SSP Biology in Kenya

3.1 In Kenya the SSP Biology Project has reached Form 3 in seventeen trial schools. Kenya has accepted responsibility for the editing and production of the pupils' text and teachers' guide for Form 4.

3.2 A writing workshop held in Nairobi in July 1970 and attended by Biology panel members from Kenya, Tanzania and Uganda, prepared the final draft of Book IV. Since then the Kenyan panel has undertaken the final editing of this volume. It was released early in 1971 and distributed to trial schools in all three East African countries.

3.3 Unlike the books for Forms 1, 2 and 3, the text for Form 4 is in one volume and caters for the first two terms of the year, leaving the third term free for revision. There are six units in the book as follows:

Unit 1. Analysis of behaviour
2. Linking systems
3. Plant reproduction
4. Genetics and evolution
5. Changes in populations
6. Man and his natural resources.

Perhaps more than the other volumes in the SSP series Book 4 draws heavily on the booklets produced by the Unesco Pilot Project for Biology teaching in Africa, Unit 6 for example following very closely the text in Unesco Volume 12 "Man and His Natural Resources."

3.4 Volume 4 of SSP Biology is attractively printed, easy to read, well illustrated and emphasises the discovery method through a series of well designed practical activities. The practical assignments for Unit 6 "Natural Resources" are of special interest as they encourage out-of-door activities close to the school in the immediate local environment.

3.5 Teachers' Guides for Volume 4 are at present in production and are being issued unit by unit on cyclostyled sheets because, while Book 4 is not at present being taught in Kenya, it is now in the SSP trial schools Form 4 in Tanzania and Uganda. These countries have therefore been supplied with unit teachers' guides as they are produced. By March 1971 guides for Volume 4 units 1 to 4 had been released.

3.6 The Teachers' Guides for Book IV are comprehensive and well organised. They do, however, have one shortcoming. Unlike the guides for years 1, 2 and 3 they lack a statement of objectives for each unit or a list of practical activities showing those which are compulsory and examinable and those which are optional. It was recommended that this information be added and this was agreed to by the Kenyan Panel.

3.7 No decision has been reached in Kenya on whether SSP Biology will spread beyond the seventeen trial schools after 1972 but the indications are that the course has succeeded so far. It is possible that the Ministry of Education may allow both traditional and SSP Biology to continue as alternatives but would strongly recommend the SSP course. This would, however, be an embarrassment to the East African Examination Council which would prefer a clear cut decision in favour of one course or the other. The matter is still to be resolved and this highlights the need for a comprehensive summative evaluation of the programme during 1972. (See SECTION 10). By then Kenya will have completed one cycle of four years and have had one public examination at O-level, while Tanzania and Uganda will have put two fourth forms through the O-level examination.

3.8 Special examination papers set by the East African Examination Council and moderated by the Cambridge Examination Syndicate will be held in 1971 for students in Tanzania and Uganda. All three countries have been involved in designing the form of the examination and in contributing questions for a sample paper to be issued by June 1971. (See SECTION 5).

3.9 Attached to this report as Appendix D are the minutes of the Kenyan Biology Panel held on Saturday, 20th February, 1971. These have been included because they bring forward the issues of current concern to the Panel. These include the preparation of the sample paper for O-level; the need for in-service activities to help SSP teacher with philosophy and teaching methods; the possible role of an international co-ordinator; the writing of the teachers' guides for Book IV and the problem of obtaining detailed feedback from trial schools.

See Appendix D

3.10 Two critical problems in Kenya have been the difficulty of mounting regular in-service courses for SSP Biology teachers in regional

centres and the difficulty of obtaining regular systematic evaluation of the effectiveness of the course. Considerable time was spent during this mission in preparing models for overcoming these problems and in mounting prototype in-service courses and evaluation studies. (See SECTIONS 11 and 13).

SECTION 4 The Problem of the International Co-ordinator for SSP Biology in East Africa

4.1 Mr. M. Chadwick was appointed by the Centre for Educational Development Overseas (CEDO) London, in October 1970 to act as curriculum co-ordinator between the three countries Kenya, Tanzania and Uganda. He was attached to the office of the Ugandan Ministry of Education Inspectorate. I had the pleasure of meeting Mr. Chadwick at the international meeting in Nairobi on Saturday, 27th February. He has excellent qualifications in biology curriculum and has had extensive experience in African countries.

4.2 The appointment of a co-ordinator had been agreed to in principle by the Ministries of Education in Kenya, Tanzania and Uganda following a recommendation by Mr. Peter Kelly of the Nuffield Science Teaching Project during a visit to East Africa in 1969. The co-ordinator was envisaged as bringing together feed back from schools in three countries and to help with final revision of books and teachers' guides. He was also to help with production of ancillary materials.

4.3 Mr. Chadwick, due to circumstances quite beyond his control, is having considerable difficulty in implementing his terms of reference. Because of the following circumstances he has not been fully accepted by the Biology Panels of the three countries, particularly those of Kenya and Tanzania.

i) Instead of being attached to the East African Examination Council, or to some other agency of the East African Community such as the Research Council, or even to the staff of a University, he was appointed to the Ministry of one only of the three countries, namely Uganda. His attachment to the Ministry of one country presents difficulties in protocol and administration for the other two countries and has been a definite barrier to the effectiveness of the appointment.

ii) A base in Kampala is geographically less convenient than a base in either Nairobi or Dar-es-Salaam. A solution would have been to have had alternating periods of 2 to 3 months in each city.

iii) The Ministries of Education in Kenya, Tanzania and Uganda were not given an opportunity to review the list of applicants for the position or to make recommendations for the appointment. This has been somewhat resented by Panel members.

iv) Panel members in all three countries naturally and correctly view the SSP Biology Project as basically a programme for East African schools, produced by Africans to meet local needs and objectives.

I attended in April 1970 (contract NS/2860/70 BOC 24.062) an international meeting on SSP Science in Kampala convened by the East African Examination Council and sponsored by CEDO. Continued references by a CEDO representative to the SSP Biology as an East African adaptation of Nuffield O-level Biology were resented by delegates to the conference. The co-ordinator, as a CEDO appointment, is therefore now seen by many Panel members to identify with Nuffield Science and to be in East Africa to promote Nuffield interests. No matter the truth or otherwise of this point of view, the damage has been done and Mr. Chadwick has been largely ineffectual in his role as co-ordinator.

4.4 There does not seem a way to retrieve the situation in its present form and in both Kenya and Tanzania there is some suggestion that co-ordination of the final revision be undertaken by a panel of three editors, one from each country. This would be an effective immediate solution. Perhaps Mr. Chadwick could assist such a committee in an advisory role.

4.5 There remains the over-all need for international co-ordination and it is suggested that another appointment be made through the auspices of a sufficiently "neutral" organization such as Unesco. Perhaps international consultants could be appointed virtually full-time who would visit various countries as requested. Such consultants could provide information on curriculum developments in other regions, run in-service courses, mount evaluation studies and assist in writing and examination workshops.

SECTION 5. Writing Workshop for Examination Items in Kenya 22nd February, 1971

5.1 On arrival in Kenya on the 15th February I was immediately asked by the Biology Panel to assist with preparing sample examination questions for Book IV SSP Biology. These were urgently required for an international panel meeting scheduled for 27th February in Nairobi. At this meeting questions were to be selected for a sample O-level examination paper for the East African Certificate of Education.

5.2 As a result of this request a workshop for panel members was convened for a full day on Monday, 22nd February. The following members of the Biology Panel and staff of Kenya Institute of Education attended:

Dr. S. Frank
Mrs. A. Glover
Mr. J. Kimura
Mr. T. Malkin
Mr. J.F. Omange
Mr. D. Pinney
Mr. J. Waikwa
Mr. F.M. Wakhu
Miss G. Wokabi

Talks were given on the use of Bloom's "Taxonomy of Education Objectives" in setting questions on O-level biology and on rules to follow in setting multiple choice; short answer and longer expression (or essay

type) questions. Members of the workshop then set draft questions on specified units of Book IV SSP Biology.

5.3 After the workshop the items were selected and edited and published in a mimeographed booklet. The booklet was printed in sufficient numbers for the international meeting of the 27th February; and for distribution to biology teachers attending in-service courses. The following is the preface to the booklet, "SSP Biology Sample Questions".

> "The questions have been designed to reflect the objectives of SSP Biology. Emphasis has been placed on understanding rather than mere recall of knowledge. Most questions involve placing the students in relatively unfamiliar situations which require interpretation.
>
> No attempt has been made to set a question on every major concept of the course but questions have been included on some of the important ideas from each unit.
>
> Questions based directly on practical work have been marked by an asterisk.
>
> With regard to essay questions, the Panel felt that when an essay is based on one specific concept only it gives undue weight to the final mark the student receives. To avoid this, the essay questions here cover broad areas rather than specific concepts.
>
> The panel is extremely grateful to acknowledge the stimulating and useful assistance of Dr. G.R. Meyer of Macquarie University, Sydney, Australia, who acted as a Unesco consultant in the preparation of these questions."

The booklet contained about four mlutiple choice questions and four short answer expression questions on each unit of SSP Book IV and seven general essays - about fifty questions in all.

5.4 The booklet was tabled at the international meeting of the 27th February and accepted as a contribution to the bank of questions for the sample SSP Biology O-level examination.

5.5 At the meeting of the 27th February discussion centred around the production of the sample paper and on problems of thoroughly evaluating the effectiveness of the first mock and actual examinations in SSP Biology. The problem of candidates who had not covered the syllabus was considered and it was agreed that sections of Books I to IV could be shown as optional sections not for examination, but that this could only apply after the final revision of the course. About 20% of each book should be marked as optional. The minutes of this meeting are given in full in this report as Appendix E.

See Appendix E

5.6 At the conclusion of the meeting Mr. S. Omenge, Secretary of the East African Examination Council, invited me to meet with the Chief Examiner and a local moderator to assist with sections of items from the bank for the sample paper. This special meeting was held that same evening and specifications and items for the sample paper were finalised.

SECTION 6. Present Situation of SSP Science in Tanzania

6.1 Since last visiting Tanzania in July 1971 the SSP Science programmes have made considerable headway, especially in Biology and Chemistry. The first O-level examination in SSP Chemistry was held last year and the first SSP O-level Biology examination is to be given in 1971.

6.2 Because the experimental phase of the project is now almost complete the Ministry of National Education would wish soon to assess the final outcome of the SSP programme and make a decision whether or not to introduce SSP Biology and Chemistry into all schools; perhaps in 1972 or 1973. The difficulty for the Ministry is that it does not have an over-all summative evaluation of the effectiveness of the new programmes or of their suitability for Tanzania. Most of the time in Dar-es-Salaam was spent on this problem. There were detailed discussions with Ministry officials and with members of SSP Panels in Biology and Chemistry. Proposals were made for an immediate summative evaluation of the new courses. Details of these discussions and proposals are given in Appendix F.

See Appendix F

SECTION 7. Present Situation of Unesco Biology Pilot Project in Zambia

7.1 Due to local changes in personnel of the Zambian Unesco study group, work went into a recess for a period of some eighteen months from May 1967 to October 1968. In November 1968, the group recommenced activity under the leadership of Mr. Denys Morgan, Reader in Science Education, Science Education Centre, University of Zambia. Members of the study group now include various professional biologists from biological institutions and the university, and representatives of the Zambian Association of Science Education (ZASE), the Agricultural Education Association, National Food and Nutrition Commission, Kadwe Teachers' College and the Ministry of Education.

7.2 The study group has carefully analysed the problems of teaching biology and has prepared a detailed statement of the objectives of teaching biology in Zambia.

7.3 Because an alternative experiment in science curriculum (the SSSPP Project) was already in trial schools in Zambia (see SECTION 8 below) the Ministry of Education decided not to experiment with the Unesco materials (July 1968). The study group, in consultation with the Ministry, therefore decided to prepare local editions of the IWG booklets as background enrichment reading for teachers and pupils. Individual professional biologists from within the panel took personal responsibility for preparing local editions. The following titles are now ready for publication, but at this stage are still in

manuscript form

i) The Living World Around Us (Unesco Unit 1)

ii) Nutrition in Man (Unesco Unit 5)

iii) Man and his Natural Resources (Unesco Unit 12)

The study group next intends to produce a local edition of Unesco Units 2 and 3 ("Plants as Food Producers" and "Animals as Food Consumers") in one volume.

7.4 The study group has been handicapped by at no stage receiving books 6, 7, 8, 9 and 11 of the series.

7.5 The study group has been active in the field of in-service training of biology teachers. These courses have not been aimed at the direct content of the current school syllabus, but at providing broad enrichment of the professional background of biology teachers. Topics of courses have included fisheries biology, forest ecology, crop plants of Zambia, general geology and wildlife conservation.

7.6 An important activity of the study group has been the production and distribution to schools of resource materials for teachers. These include booklets on Museum techniques, crop plants, wildlife conservation and school health problems.

7.7 For administrative reasons, it was not possible during my short time in Zambia to meet the members of the Panel as a group. Mr. Morgan, however, escorted me to a number of university departments, government departments, biological research institutes and other centres. It was possible in this way to meet many individual members of the panel and to discuss the growing links between these institutions and the schools.

See Appendix C

7.8 In appraising the effectiveness of the work of the Panel, judgment is difficult, because, through no fault of the leadership or the membership, work has of necessity been tangential to the main line of curriculum development in Zambia. There is no doubt that the work of the Panel has achieved a great deal in making local and expatriate teachers aware of the resources of their environment and of how these resources can be used in the classroom. The lack of <u>direct</u> relevance of some activities to the curriculum has been a handicap. Now that the SSSPP experiment (see SECTION 8) is about to conclude, there is an opportunity for the Panel to return to the main-stream of curriculum development by co-operating with the new Curriculum Development Centre of the Ministry of Education. It is now time for a new biology curriculum in Zambia.

SECTION 8. <u>Secondary School Science Pilot Project (SSSPP) in Zambia</u>

8.1 In February 1976, the Ministry of Education and the Science Education Centre of the University of Zambia launched an experimental programme

for Forms 1-5 in Chemistry, Physics and Biology. Teaching commenced in five trial schools in January 1968 and has now reached the third form in all trial schools, but has not been extended into fourth or fifth forms. The materials used were those produced by the O-level Nuffield Science Project in England. This was done in order to orient the Zambian schools towards the problem solving or "discovery" method of teaching in the belief that at the time there were insufficient local resources to develop a new Zambian curriculum starting from first principles.

8.2 A considerable difficulty in evaluating the over-all effectiveness of the course and its suitability for Zambia has arisen because of the initial choice of trial schools. The trial schools at April 1971, were with one exception, all "well-established schools with acknowledged high level of teaching and promising pupils". The exceptional school was a newly established Day Secondary School with its first intake in 1970. All schools had excellent, well equipped laboratories and were staffed by well qualified and experienced science teachers, mostly expatriate. With such excellent school conditions, it would be unlikely for any new science course to be ineffective, and therefore it is not easy to generalise from the trial schools to the Zambian schools as a whole.

8.3 The project has been supported by funds from UNICEF, CEDO and the British Council. Very extensive apparatus, some very sophisticated, and books, sufficient to supply six schools for a five year course in each of Biology, Chemistry and Physics were donated by UNICEF. UNICEF also met the costs of some in-service courses and conferences. Total cost fo UNICEF was in the order of US$78,000.

8.4 One year after the project had started, the Government of Zambia changed the structure of the secondary school course from 2 years Junior Secondary and 3 years Senior Secondary to 3 years Junior and 2 years Senior. 50% of secondary pupils now leave after Form 3. It was agreed in 1971 not to extend the SSSPP programme beyond Form 3. Also in 1971, a new approach was adopted by producing guides for teachers for the integration of the Chemistry, Physics and Biology in the first year. Notes are now in preparation for an integrated second year. In Forms 4 and 5, pupils take the conventional O-level courses of the Cambridge Examination Syndicate in Physics, Chemistry and Biology.

8.5 An important aspect of the programme has been the development by the Ministry and the Science Education Centre of Teachers' Notes and Pupils' Worksheets. Most progress in this regard has been with Physics. In Chemistry, much use has been made of material prepared in East Africa (SSP). The material for the Biology course is less well advanced.

8.6 A special SSSPP Form 2 examination was held for the first time in December 1969. Stress was placed on understanding rather than recall of factual knowledge and the paper contained three sections: multiple choice type questions, short answer type questions and a comprehension passage. The standard was satisfactory. A second Form 2 examination was set in 1970. In 1971, the first Third Form SSSPP examination will

be held. In some cases the examiners have set questions rather beyond the ability of the candidates, but in general the standard has been satisfactory in these examinations.

8.7 As the SSSPP course was the only experimental programme mounted officially by the Ministry of Education in Zambia, and as the Unesco Study Group had not as yet become directly involved in curriculum I was asked on arrival, to undertake a preliminary summative evaluation of the SSSPP programme. This request came from the Science Education Centre of the university through a formal letter to the UNDP office in Lusaka. In the time available, I agreed to assess only SSSPP Biology and to work co-operatively with the officials of the newly established Curriculum Development Centre of the Ministry of Education (see SECTION 9). The evaluation study is discussed in SECTION 2 and a full report of the study is given as part of Appendix G.

See Appendix G

8.8 The evaluation study clearly showed that within the five trial schools, SSSPP had been successful in attaining its objectives and was being taught at a good standard. It was less clear, however, whether the objectives were appropriate for Zambia. The study also revealed that the course had a very poor chance of success if introduced in its present form to all secondary schools in Zambia.

8.9 A recommendation was made that new courses of Biology and Physical Science be gradually phased in form by form over the next five years (3 + 2) and that SSSPP be simultaneously phased out of the trial schools. The experience gained from SSSPP, and many materials produced for that course, would be valuable in the development of the new programmes. SSSPP would "seed" the new courses, but the new courses would start at first principles based on analysis of the needs and objectives of Zambia. These proposals were heard sympathetically by the Inspectorate of the Ministry of Education, by the Director and staff of the Curriculum Development Centre and by the Science Education Centre of the University of Zambia. It was further suggested that the Physical Science and Biology be eventually linked to Agriculture in the development of an integrated science programme, initially for years 1 to 3 and eventually for years 4 and 5.

SECTION 9. Newly Established Ministry of Education Curriculum Development Centre (CDC) in Zambia

9.1 The Ministry of Education has recently (August 1970?) brought its English programme and its various curriculum projects together into a Curriculum Development Centre. This is located in its own well equipped buildings in Lusaka, and is staffed by teachers, inspectors and curriculum officers appointed on a full-time basis. The Director is Mr. J. Barks, previously an Her Majesty's Inspector (H.M.I.) in Britain, and the Science Curriculum Division is under the direction of Mr. J. Huxley, previously an Inspector of Science in the Ministry of Education, Zambia.

9.2 At present, the priorities are in primary curriculum, but the Centre also has the responsibility of secondary school curricula and immediately must take action on the current SSSPP experiment. The Director and Science staff were most interested in the proposals to phase out SSSPP and to begin again with a new programme starting in Form 1, perhaps in 1973.

9.3 There are two serious problems in the organization of the Centre. The first is that few of the staff have had formal training in curriculum. Most are experienced teachers or inspectors, but have had little training in the techniques of curriculum development or evaluation or in the production of materials for schools. At the request of the Director, a seminar for the CDC staff was given on the 3rd April on techniques of obtaining feedback from trial materials and on problems of formative evaluation of new curricula. This was well attended and there was lively discussion. The second and related problem is a general shortage of staff. There is in most cases only one member of staff for each major subject field, who is responsible for both primary and secondary levels. In discussions with the Director, it was strongly recommended that subject panels be set up for each new curriculum development and that in the case of primary and secondary sciences, considerable support should come from the Science Education Centre (SEC) of the University and from the Zambia Association of Science Education (ZASE). Discussions with representatives of SEC and ZASE developed further this concept of liaison with CDC and the idea was accepted with enthusiasm.

9.4 In spite of difficulties of staff and resources, I am convinced that the CDC represents a major advance in education in Zambia. It provides a focal point for curriculum development and will, for example, give the Unesco Biology Study Group, under the leadership of Mr. Denys Morgan of SEC, a direct link with the mainstream of curriculum workers. The excellent work so far accomplished by the Study Group can now through CDC make a direct impact on biology courses in school.

SECTION 10. Work of the Zambia Association of Science Education (ZASE)

10.1 The Zambia Association of Science Education (ZASE) is one of the most active science teachers' associations in African countries. It has a strong membership and is led by enthusiastic and hard-working science teachers.

10.2 Apart from the usual series of meeting and conferences, ZASE has sponsored writing workshops for the production of materials for schools. A number of valuable publications has been printed and issued to schools. Titles include :

Safety in Schools - Legal Aspects
Organization of Practical Exams in Science
Physics Apparatus Drawings
Class Experiments in Biology
Common Zambian Flora
Using the Microscope
Optical Equipment - Care and Storage
Teaching Notes for J.S.S.L.E. General Science
Physical Science Teaching Notes

In addition, the Association issues an excellent journal "Zase Bulletin" which contains articles produced mainly by science teachers in Zambia.

10.3 Formal meetings with ZASE were arranged on two occasions. The first was a meeting on Saturday, 27th March at SEC with members of the Biology Sub-committee. Activities of the Sub-committee to date were reviewed and discussion centred on future policy. It was agreed that the Sub-committee should attempt to analyse the aims and objectives of biology teaching in Zambia as a guide for the work of the Curriculum Development Centre. The second contact was at a meeting of the Executive of ZASE at the home of the Professor of Physics, Professor Ward, on the occasion of the farewell to Professor Yates of SEC, the immediate past President of ZASE and editor of "Zase Bulletin". At this meeting, I was asked to address the Association and to lead a discussion on future policies. At the conclusion of discussions, it was agreed that the Association should prepare a manifesto on the aims and objectives of science education in Zambia as a blue-print for new curricula to be developed by CDC. It was further agreed that the Association should form an important part of a study group in science to be set up by CDC and that it would work very closely with CDC in the development of new science courses for Zambia.

SECTION 11. Curriculum Evaluation Studies in Kenya, Zambia and Malawi, February to April 1971

11.1 In each of Kenya, Zambia and Malawi, experimental programmes in biology are in trial form in selected schools. In Kenya, SSP Biology had reached Form 3 in seventeen trial schools. In Zambia, SSSPP Biology had reached Form 3 in five trial schools and in Malawi, a two-year programme based on the Unesco Pilot Project had reached second form in give trial schools. In all three countries, considerable interest was shown in methods of assessing the effectiveness of these experimental curricula. I was asked, therefore, to give some guidance in simple techniques of curriculum evaluation. In each case, I decided to meet this request not by giving lectures or workshops, but to actually attempt, with the aid of members of local Study Groups or curriculum workers, a preliminary summative evaluation study of the course in each country.

11.2 The purpose of the evaluation studies therefore was, primarily, to train local people in methods of curriculum assessment appropriate for developing countries with limited resources in staff and finance. The actual findings of the studies would be of interest and value in their own right but were incidental to the main objective.

11.3 In each case, the evaluation aimed to gain evidence about the following:

i) The retention and development of key concepts from form to form;

ii) the effectiveness and acceptability of the discovery approach from the point of view of pupils and teachers;

iii) the relevance and suitability of the objectives and content for the country concerned;

iv) administrative problems and teaching difficulties associated with the new programme;

v) the extent to which the course could successfully transfer from the trial schools to the general school system of the country concerned;

vi) some recommendation for the possible future of the course.

11.4 In each country, the following techniques were used.

i) A representative class from each form was given a short multiple choice achievement test on a specified unit of basic work covered in the first form. The general area of the test was the basic concept of classification as a process in biology and as this topic is common to first year courses in most countries, it was possible to use the same test with minor local adaptations in each of the three countries. This gave valuable comparative data. In Malawi, but not in Kenya or Zambia, it was also possible to administer this test in two closely matched control schools offering the alternative "traditional" programme (x)

ii) Each pupil was asked to write a short statement on what he liked and did not like about his biology course. In Malawi, this was also undertaken in the control schools (x)

iii) The school principal and the biology teacher were interviewed about the acceptability of the new programme and especially about its potential transferability to other schools and about specific problems and difficulties. In Kenya, this interview was standardised and based on a questionnaire that had been prepared by the SSP Panel before my arrival and which had been previously circulated to trial schools. In Zambia and Malawi, the interview was standardised on a set of especially prepared questions.

(x) The control schools were:

i) H.H.I. Secondary School,
P.O. Box 96,
Blantyre.

Biology teacher - Mr. Chimaliro

ii) Chichiri Secondary School,
P.O. Limbe.

Biology teacher - Miss Murasi

iv) The facilities for teaching biology in laboratories, classrooms and school grounds were observed.

v) Shortly after leaving the school, the curriculum evaluators assessed all the evidence from the visit and used this to obtain ratings on various criteria of acceptability and effectiveness of the new course.

11.5 In Malawi, two additional procedures were used

vi) A demonstration lesson given by the trial teacher was observed and rated on the degree of achievement of stated objectives and on the use of recommended teaching strategies.

vii) A micro-lesson was given by one of the curriculum workers to assess the problem-solving skills of a given class. Response of the class was rated on a number of criteria.

11.6 The essential aims of the evaluation studies were achieved. Local curriculum workers clearly understood the simple methods used. They were enthusiastic about the quantity and usefulness of the data obtained by a short visit to a trial school, in spite of limited resources and staffing at the curriculum centre.

11.7 The results of the preliminary evaluations were in themselves of considerable interest. They revealed different levels of acceptability, effectiveness and potential transferability in the three countries. The results are given in full in Appendix G and some comparisons between the three countries are discussed in SECTION 13 below.

See Appendix G

11.8 In addition to these studies in summative evaluation of trial courses, seminars and in-service lectures and informal discussions were held in the techniques of formative curriculum evaluation - especially on the use of diagnostic profiles and other devices for obtaining and using feedback from trial schools.

SECTION 12. Present Situation of Unesco Biology in Malawi

12.1 From the outset in Malawi, the Unesco Biology Study Group has been closely associated with the Ministry of Education, and is now directly responsible to the Ministry. The University of Malawi takes an interest in the group, the present Chairman being Dr. Peter Mwanza of the School of Biology, but the majority of active members are Malawian teachers. The Acting Secretary of the group is Mr. Stan Moss, Science Inspector, Ministry of Education, and he has given direction and leadership to the more recent phases of curriculum construction.

12.2 In October 1969, five pilot schools were selected to trial certain Unesco Pilot Project booklets for the Junior Certificate Examination course in Forms 1 and 2. The booklets selected were Units 1 to 6, and 8 to 10. Other material from the series was to be reserved for a new syllabus for the Malawi Certificate of Education programme in years 3 to 5.

12.3 In October 1970, the experiment reached Form 2 in the trial schools and in August 1971 the first Junior Certificate Examination for the new course will be held.

12.4 The study group has prepared teaching notes to supplement the Unesco Teachers' Guides. In particular, a detailed set of behavioural objectives has been prepared for each unit which gives specifications for the J.C. examination and directionalises the teaching. A valuable newsletter "The Modern Biology Teacher of Malawi" is issued by the study group and sent to all schools. It contains excellent letters and articles by Malawian teachers.

12.5 A number of orientation and in-service courses has been given for trial teachers led by Mr. Moss and by university personnel.

12.6 At present the Unesco booklets have been used with only minor omissions and slight adaptations, deliberately as an experiment to detect the need for change. At this stage (April 1971) one central problem has emerged. Teachers do not know whether the authors of the books intended them as textbooks; background readers; workbooks or as combinations of these. At an in-service course held 13th to 16th April, considerable attention was given to this problem - see SECTION 13 below.

12.7 On the whole, though, without having completed a systematic evaluation, the group was convinced that the booklets would form the basis of a satisfactory programme for Malawi. The books could be selected to make a course complete in itself, and that is of great significance in Malawi, since 35% of Form 2 does not proceed to Form 3. The course, however, seemed to provide a good base for further studies, being especially suitable as background for the new M.C.E. course being planned for Forms 3 to 5. The structure of the course seemed to be well organised, the units smoothly following one another. The emphasis on ecology and inter-relationships and on human problems seemed appropriate for Malawi and led smoothly to the senior course.

12.8 The study group, however, had reached the stage of requiring both an overall assessment of the project based on more systematic evaluation and guidance in methods of obtaining feedback for a final rewriting of the materials for Malawian schools. Most time in Malawi was spent with the study group on these matters. See SECTIONS 11 and 13.

SECTION 13. <u>In-service Courses for Biology Teachers and Writing Workshops in Kenya and Malawi</u>

13.1 In Kenya, some in-service orientation courses in SSP Biology had been given from time to time at the Kenya Institute of Education but courses in regional centres had not been given on a regular basis. Teachers not in the SSP trial schools were most interested in the philosophy of the new course and K.I.E. had received many requests for details of the experimental course. It was decided, therefore, to combine some one-day in-service meetings in regional centres during the same safari organised for the evaluation study (see SECTION 11). Four courses were

given - one each at Kisii, Kisumu, Nakuru and Nairobi.

13.2 In the Kenyan courses, the programme was designed for both SSP and non-SSP Biology and emphasised the discovery method of teaching and the problem-solving type of examination. Teachers were given an opportunity to construct multiple choice objective questions for either the SSP or conventional biology programmes. The teachers of conventional biology were encouraged to apply the discovery method of teaching in normal classroom activities.

13.3 In Kenya, approximately 100 teachers attended the courses.

13.4 In Malawi, a central course of four days was held at Chancellor College in Blantyre for the biology teachers of the five trial schools, following the Unesco biology course in Forms 1 and 2. The purpose of the course was to review teaching problems, to prepare for the teaching of Unit 10 Unesco; to train in methods of objective testing; to consider ways of obtaining more efficient feedback for revision of the books and to draft mock-ups of a format for the revised edition. These objectives were achieved by the course, and the teachers were most enthusiastic and productive.

13.5 Details of these courses in Kenya and Malawi, with lists of participants and appraisals of their effectiveness are given in Appendix H of this report.

See Appendix H

13.6 During the in-service course in Malawi, the teachers developed a new format to be followed in the final version of the books. It was agreed to use Unit I, Section 4 "Grouping Things" for a prototype revision, and to produce both a pupils' text and teachers' guide. The prototype layout is given in this report as Appendix I.

See Appendix I

13.7 An especially successful aspect of the course in Malawi was one and a half days of training in field methods. A comprehensive Teachers' Field Guide was prepared for a given area of grass and timber. The guide was deliberately designed to introduce teachers to as many simple field techniques as possible. The teachers were taken to the field and completed all the assignments listed in the study guide. They were amazed and impressed at the vast amount of useful information that was collected by using the simple methods advocated. The field studies were then related to Unesco Unit 10 and there was discussion on which aspects might be suitable for more senior forms. The Field Study Guide is presented in this report as Appendix J.

See Appendix J

SECTION 14. Some Comparisons Between Kenya, Malawi and Zambia

14.1 The following table summarises some of the points of similarity and difference between the new biology curricula of Kenya, Malawi and Zambia.

Feature of the Curriculum	KENYA (SSP Biology)	MALAWI (Unesco Biology)	ZAMBIA	
			Unesco Pilot Project	SSSPP Biology
Forms for which designed	1 to 4	1 and 2	Nil	1 to 3
Number of trial schools	17	5	Nil	5
Use made of Unesco Pilot Project materials	Fused with other resources such as Nuffield O-level Biology, BSCS, and local materials in the development of an East African programme	Unesco Units 1-6 and 8-10 form the entire course to the Junior Certificate Examination	As enrichment materials. Local editions still in production	Nil
Final format of materials	Four Pupils' Books and four Teachers' Guides, one volume for each form	To be re-written and developed as a single textbook with Teachers' Guide	To be issued as separate booklets designed mainly for teachers	Nuffield publications plus cyclo-styled teaching notes
Main strength	Correct objectives. Enthusiastic response by pupils and teachers. Good learning materials	Correct objectives and correct level. Liked by pupils and teachers. Excellent learning materials	Valuable resources for teachers on aspects of biology in Zambia	Has prepared a key group of schools for a new phase of curriculum development with an emphasis on discovery learning

Feature of the Curriculum	KENYA (SSP Biology)	MALAWI (Unesco Biology)	ZAMBIA	
			Unesco Pilot Project	SSSPP Biology
Main problems and shortcomings	Transfer of staff from trial schools. Difficulty of holding regular in-service courses. Lack of continuous systematic feedback. Course at present too long and some parts too difficult (especially Form 3)	Need to obtain effective continuous feedback for final revision of book	Not linked to school curriculum and therefore not contributing to mainstream of biology teaching. Mostly being redeveloped by professional biologists with few teachers involved	Heavy reliance on expatriate teachers. Objectives not suitable for Zambia. Specialised equipment available only in trial schools. Poor chance of success outside trial schools
Attitude of pupils to the new course	Excellent	Excellent	-	Very good
Pupils' ability to develop concepts through discovery learning	75%	75%	-	60%
Prediction of success if transferred from trial schools to all schools	80%	90%	-	20%

14.2 In summary, Kenya and Malawi have developed locally oriented programmes with high prediction of success in the school systems of their countries. Zambia has, by adapting materials from overseas, produced the right environment for curriculum change and is now ready to develop its own local programme.

SECTION 15. Appraisal and Recommendations

15.1 The missions to Kenya, Malawi and Zambia were successful in providing training in techniques of formative and summative evaluation. In each

case, thorough reports were prepared on the evaluation of the local biology curricula (see SECTION 11). These indicated a high level of success with the new programmes in Kenya and Malawi, and in Zambia the establishment of an appropriate climate for a new development in biology curriculum.

15.2 In Kenya and Malawi it was possible to provide in-service training courses for local biology teachers in out-of-doors teaching, discovery learning, evaluation techniques and modern methods of examining

15.3 Writing workshops were held in both Kenya and Malawi on the preparation of examination questions and (in Malawi) on preparing prototypes for pupil books and teachers' guides for the local edition of the Unesco booklets. These writing workshops were most successful and the materials produced were of high quality.

15.4 The visit to Dar-es-Salaam was particularly timely as the Ministry of National Education was requesting advice from panels on whether or not to continue with SSP Science in Tanzania. It was possible to meet members of Chemistry and Biology Panels and to help formulate plans for the preparation of evaluative reports for the Curriculum Division of the Ministry.

15.5 Because of the limited time in each country, the mission would not have been a success without careful pre-planning by Ministry officials, especially in regard to arranging in-service courses. I am most grateful for this co-operation. The local study groups of each country also co-operated with enthusiasm and arranged many appointments and details of the itinerary well in advance. Only by such close co-operation was it possible to complete this ambitious programme of evaluation and training within the three to four weeks in each centre

15.6 All countries visited were anxious for continued links with Unesco and, if possible, for continuing support with either finance for the development stages or by the appointment of further consultants to assist with the preparation of learning materials. In Malawi, there were also requests for a sub-regional consultant for southern African countries to spend up to three months each in countries such as Botswana, Lesotho, Malawi, Swaziland and Zambia. The Malawian panel also asked for some fellowships for members of the study group to be given overseas training in the production of learning materials.

15.7 To ensure continued development of the initial work of the Unesco Pilot Project, it is recommended therefore that one or more sub-regional consultants be appointed virtually full-time. Each would run in-service courses and assist with local production of materials in selected countries. Part of this work would be to mount evaluation studies of the effectiveness of new courses and to train local curriculum workers in the techniques of formative and summative curriculum evaluation.

15.8 In the longer term, there is clearly the need in Africa for the establishment of two or three sub-regional centres for the development of learning materials. Such centres could either be specialised by curriculum

area (e.g. science or social science) or by geographical sub-region (e.g. West Africa, East Africa) or by language (e.g. serving French-speaking or English-speaking countries). Their task would be to produce prototype learning materials much on the model of the Unesco Biology Pilot Project. These prototype materials would then be re-developed by study groups in National Curriculum Development Centres (e.g. Kenya Institute of Education or Zambia's new Curriculum Development Centre). It would also be the responsibility of the sub-regional centres to train and supervise personnel of national centres and to provide a co-ordinating role in sharing experiences and exchanging materials. In this way, the Unesco Biology Pilot Project for Africa would be assured of leading to lasting curriculum change and at the same time, new developments such as those proposed in Zambia, would be given support and international recognition.

APPENDIX A

PROGRAMME OF ACTIVITIES OF G.R. MEYER IN TANZANIA, KENYA, ZAMBIA AND MALAWI 15th FEBRUARY TO 24th APRIL 1971

	Activity	Date Commenced	Date Finished
I.	KENYA (15.2.71 to 14.3.71)		
1	Critical examination of recently completed SSP Book IV and of first drafts of Teachers' Guides for Book IV Units 1 to 4	16.2.71	25.3.71
2	Workshop for members of SSP Biology panel on construction of examination questions for SSP Biology at O-level	22.2.71	-
3	Attendance at specific committee meetings:		
	i. Regular meeting of Kenyan Biology Panel	20.2.71	-
	ii. Special meeting of SSP Biology International Panel to prepare a sample paper for the East African Examination Council	27.2.71	-
	iii. At request of Secretary of E.A.E.C. a special meeting with Chief Examiner and moderator SSP Biology to select questions for sample paper	27.2.71	-
4	Co-ordination of production of a set of sample examination questions based on units for SSP Book IV	18.2.71	27.2.71
5	Preparation of notes for in-service courses for SSP Biology teachers	16.2.71	2.3.71
6	One day in-service courses for SSP Biology teachers in regional centres:		
	i. Kisii	5.3.71	-
	ii. Kisumu	6.3.71	-
	iii. Nakuru	10.3.71	-
	iv. Nairobi	13.3.71	-
7	Visits to five trial schools to evaluate the effectiveness of SSP Biology in Kenya. Design of instruments and preparation of report	20.2.71	12.3.71

	Activity	Date Commenced	Date Finished
II.	TANZANIA (13.3.71 to 16.3.71)		
8	Consultations with members of Tanzanian Biology and Chemistry Panels	15.3.71	16.3.71
9	Discussion with officials of Ministry of National Education	16.3.71	-
III.	ZAMBIA (17.3.71 to 2.4.71)		
10	Discussions with Mr. Denys Morgan and members of Unesco Biology Study Group on effective use of Unesco Pilot Project Booklets as enrichment materials for schools	20.3.71	31.3.71
11	Visits with Mr. Morgan to Institutes of Biology and Ministry Departments co-operating with the production of Zambian editions of the Unesco booklets	25.3.71	27.3.71
12	Discussions with staff of Science Education Centre University of Zambia on research programmes in science education	18.3.71	20.3.71
13	Visits to SSSPP trial schools and other educational institutions to evaluate effectiveness of SSSPP Biology in Zambia	23.3.71	1.4.71
14	Discussions and seminar at the Curriculum Development Centre of the Ministry of Education on techniques of curriculum evaluation	22.3.71	1.4.71
	Seminar for staff	1.4.71	-
15	Meetings with committees of Zambian Association of Science Education (ZASE) to consider role of the association in curriculum development:		
	i. with biology sub-committee	27.3.71	-
	ii. with executive committee	1.4.71	-
16	Discussions with science inspectors of the Ministry of Education on future of biology teaching in Zambia	22.3.71	-
17	Final discussions with UNDP and with Vice-Chancellor and Dean of Natural Sciences in University of Zambia	2.4.71	-

	Activity	Date Commenced	Date Finished
IV.	MALAWI (3.4.71 to 24.4.71)		
18	Visits to Unesco trial schools to evaluate the effectiveness of Unesco Biology for Forms 1 and 2 in Malawi	5.4.71	8.4.71
19	Preparation of detailed report on the evaluation of Unesco Biology Forms 1 and 2 in Malawi	7.4.71	20.4.71
20	Easter recess used for preparation of notes for teachers workshops and in-service programme	9.4.71	12.4.71
21	Writing workshops and in-service courses for biology teachers (members of the local study group)	13.4.71	16.4.71
22	Lectures to students of the University of Malawi on recent developments in biology teaching:		
	i. Chancellor College Biology Department	20.4.71	-
	ii. Soche Hill Teaching College	22.4.71	-
23	Radio broadcast for Malawi Broadcasting Commission on the Unesco Biology Pilot Project in Malawi	19.4.71	-
24	Discussions with officials of Malawi Ministry of Education; Department of External Aid; Regional Testing Centre and with UNDP	19.4.71	24.4.71

APPENDIX B

PERSONNEL INVOLVED IN BIOLOGY TEACHING PROJECTS IN KENYA, TANZANIA, ZAMBIA AND MALAWI, INTERVIEWED BY G.R. MEYER 15th FEBRUARY TO 24th APRIL, 1971

I. KENYA

A. Members of SSP Biology Panel (Kenya)

Attending meeting of biology panel at Kenyan Institute of Education (K.E.I.) Nairobi, Saturday 20th February, 1971

Dr. J.M. Waithaka, Chairman	University of Nairobi
Mr. J. Kimura, Secretary	Kenyan Institute of Education
Dr. N. Erneholm	Kenyatta Secondary Teachers College (KSTC)
Dr. S. Frank	Kenyan Institute of Education
Mrs. A. Glover	Pangani Girls School
Mr. T. Malkin	Njiris School
Mrs. J. Mucheki	Kenyan Institute of Education
Mr. P. Nderu	Ministry of Education
Dr. S. Nillsen	Unesco Consultant
Mr. I. Omendi	Machakes High School
Mr. J.F. Omange	K.S.T.C.
Mr. D. Pinney	Thika High School
Mr. F.M. Wakhu	K.S.T.C.
Miss G. Wokabi	Kenyan Institute of Education

B. Personnel Attending International SSP Biology Panel Meeting held at Kenya Institute of Education, Nairobi, Saturday 27th February, 1971

	Representing
Mr. S. Omenge	East African Examination Council
Dr. S. Frank	Kenya
Mr. J. Hogg	Kenya
Dr. Rex Meyer	Kenya
Mr. P. Nderu	Kenya
Mr. B. Chaplin	Tanzania
Mr. Blilla	Tanzania
Mr. A. Meena	Tanzania
Mr. D.T. Chadwick	Uganda
Mr. T. MacPherson	Uganda
Mr. T. Sedden	Uganda

C. Staff of Unesco Field Science Office for Africa

Dr. O. Ibukun, Director
Dr. D. Saint Rossy, Deputy Director

II. TANZANIA

A. Ministry of National Education

Mr. R.S. Seme	Assistant Director in Charge of Curriculum
Mr. M.G. Kayuze	Secretary General, Tanzania Unesco National Commission
Mr. R. Kiyao	Assistant to Mr. Seme

B. Member of SSP Biology Panel

Mr. B. Chaplin	Institute of Education, University of Dar-es-Salaam
Miss A. McCusker	Botany Department, University of Dar-es-Salaam
Mr. A. Meena, Secretary	Institute of Education, University of Dar-es-Salaam

C. Members of SSP Chemistry Panel

Mr. J. Kent	Institute of Education, University of Dar-es-Salaam
Mr. J. Pendaeli	Institute of Education, Dar-es-Salaam

D. Other University Authorities

Professor Samaan	Department of Education
Mr. A.A. Lema	Director, Institute of Education

E. Unesco and UNDP

Mr. F.I. Ajumogobia	Unesco Chief of Mission
Miss R. Wilson	Assistant to Resident Representative UNDP
Mr. G. Duncan	Project Manager, Unesco Science Teaching Project, Chemistry Department, University of Dar-es-Salaam

III. ZAMBIA

A. At Ministry of Education

Mr. M. Mumbwe	Chief Inspector of Schools
Mr. M. Capel	Science Inspector
Mr. R. Syme	Science Inspector

B. Science Education Centre of University of Zambia

Professor E.L. Yates	Director
Mr. Denys Morgan	Reader in Science Education Secretary Unesco Study Group
Mr. E. Obiola	Lecturer in Science Education
Mr. P.E. Khabele	Lecturer in Science Education

C. Other University Personnel

Professor L. Goma	Vice-Chancellor
Dean Diaper	Dean of Natural Science
Professor Ward	School of Physics
Professor Miles	Department of Zoology

D. Staff of Ministry of Education Curriculum Development Centre

Mr. J. Barks	Director
Mr. J. Huxley	Science Inspector

E. Note: It was not possible to meet members of the Zambian Unesco Study Group at a regular meeting

IV. MALAWI

A. Ministry of Education

Mr. L. Anthony	Permanent Secretary
Mr. L. Mallunga	Chief Education Officer
Mr. J. Kanuka	Assistant Chief Education Officer
Mr. H. Mbale	Assistant Chief Education Officer
Mr. S. Moss	Inspector of Science Teaching and Acting Secretary of Unesco Study Group

B. University of Malawi Department of Biology

Professor Margaret Kalk	
Dr. N.P. Mwanza	Senior Lecturer
Dr. M. Reed	Lecturer

C. University of Malawi, Soche Teachers' College

Mr. John Fletcher	Lecturer in Agricultural Education
Mr. E. Mwasi	Lecturer in Biology

D. UNDP

Mr. V. Furst	Assistant Resident Representative

E. Current Membership of Malawi Biology Study Group (April 1971)
(Those met personally marked *)

Address : Unesco Biology Study Group,
P.O. Box 5200,
Limbe. Malawi

Members : *Dr. N.P. Mwanza, Chancellor College (Leader)
*Mr. Stan Moss, Ministry of Education (Acting Secretary)
*Professor Margaret Kalk, Chancellor College

Members : Professor Blodwen Binns, Soche Hill College and University of Malawi Herbarium
*Dr. M.L. Reed, Chancellor College
*Mr. J. Davis, Malosa Secondary School
Miss E. Chipasula, Chancellor College
*Mr. I. Medi, Blantyre Secondary School
*Mr. D.J.K. Kayira, Chiradzulu Secondary School
*Mr. B. Mkandawire, St. Patrick's Secondary School
*Mr. A. Zoani, Soche Hill Secondary School
*Mr. Z. Chirambe, Malosa Secondary School
*Mrs. F. Mbale, Malosa Secondary School

APPENDIX C

VISITS TO SCHOOLS AND OTHER EDUCATIONAL INSTITUTIONS
15th FEBRUARY - 24th APRIL, 1971

I. KENYA

	Name and Address of School or Institution	Dates	Purpose of Visit	Personnel Interviewed
1	Kenya I. of Education P.O. Box 30231 Nairobi.	15.2.71 to 13.3.71	Host office	See Appendix B
2	Unesco Field Science Office for Africa, P.O. Box 30592, Nairobi.	14.2.71 to 13.3.71	Administration	See Appendix B
3	Kipsgis G. Sec. School, P.O. Box 194, Kericho.	4.3.71	Evaluation SSP Biology	Acting Headmaster Biology staff
4	Tenwek Sec. School, P.O. Box Bomet, Sotik.	4.3.71	Evaluation SSP Biology	Headmaster: Mr. Charles Sang Biology staff
5	Kisii Sec. School, P.O. Box 11, Kisii.	5.3.71	In-service course	Headmaster: Mr. Walobwa Biology staff: Mr. N.J. Indge (S.B.M.)
6	Kisumu High School, P.O. Box 127, Kisumu.	6.3.71	In-service course	Inspector of Schools Nyanza Province: Mr. Noble Biology Master
7	Kibabii Sec. School, P.O. Box 85, Bungoma.	8.3.71	Evaluation SSP Biology	Biology staff: Mr. Tomlinson
8	Friend's School, Kamusinga, P.O. Broderickfalls.	8.3.71	Evaluation SSP Biology	Headmaster: Mr. Masinde Biology staff: Mr. J. Wasike Mr. Olende
9	Kapsabet G.H. School, P.O. Box 20, Kapsabet.	9.3.71	Evaluation SSP Biology	Biology staff: Mrs. Tischler
10	Nakuru Sec. School, P.O. Box 661, Nakuru.	10.3.71	In-service course	School Inspector Rift Valley Province: Mr. Blevins

II. TANZANIA

	Name and Address of School or Institution	Dates	Purpose of Visit	Personnel Interviewed
1	Institute of Education, University of Dar-es-Salaam Box 35091, Dar-es-Salaam.	15.3.71	Discussions on evaluation of SSP Science	See Appendix B
2	Ministry of National Education, Box 9121, Dar-es-Salaam.	16.3.71	Discussions on future of SSP Science	See Appendix B
3	UNDP, P.O. Box 9182, Dar-es-Salaam.	15.3.71	Administration	See Appendix B

III. ZAMBIA

1	Science Education Centre, University of Zambia, Box 2379, Lusaka.	17.3.71 to 2.4.71	Host office and discussions with staff on research problems.	See Appendix B
2	Ministry of Education Curriculum Development Centre, P.O. RW92, Lusaka.	18.3.71 to 1.4.71	Discussions on curriculum evaluation	See Appendix B
3	Ministry of Education, Lusaka.	22.3.71	Discussion of future of Biology teaching in Zambia	See Appendix B
4	UNDP, P.O. Box 1966, Lusaka.	17.3.71 to 2.4.71	Administration	Regional Representative: Mr. A.C. Gilpin Fellowship and Programme Officer: Mr. C.E. Wiberg
5	Munali Secondary School, Box 655, Lusaka.	23.3.71	Evaluation SSP Biology	Headmaster: Mr. F. Legg Science staff: Mr. A. Sansom Mr. S.G. Khonje Mr. V. Mahole
6	David Kaunda Sec. Tech. School, Box RW133, Lusaka.	24.3.71	Evaluation SSP Biology	Headmaster: Mr. A. Corbett Biology staff: Mr. M. Bingham Mr. M. Wickson

	Name and Address of School or Institution	Dates	Purpose of Visit	Personnel Interviewed
7	Libala Sec. School, Box RW18, Lusaka.	24.3.71	Inspection of Agribiology programme and as a control for SSSPP evaluation	Headmaster: Mr. L. Nefdt
8	Natural Resources Development College, Box CH99, Chelston. Lusaka.	26.3.71	Discuss links with biology curriculum in secondary schools	Principal: Mr. A. Hamaamba
9	Canisius Sec. School, P.O. Chisekesi	30.3.71	Evaluation of SSSPP Biology	Headmaster: Father T. McGiven Science staff: Father D. McKenna, Mr. P. Mullins, Mr. D. O'Keefe, Mr. K. Van Putten, Father G. O'Connell
10	Monze Sec. School, Box 198, Monze.	30.3.71	Control school for comparison with SSSPP Biology	Headmaster: Mr. W. Gyde Science master: Mr. S. Rossa
11	King George VI Sec., Box 73, Kabwe.	31.3.71	Evaluation SSSPP Biology	Headmaster. Mr. R. Brown Science staff. Mr. V. Chelliah, Mr. M. Averill, Mr. C. Thorp, Mr. T. Owens
12	Kabwe Teacher Training College, P.O. Box 404, Kabwe.	31.3.71	Discussions of teacher training for SSSPP Biology	Principal: Mr. P. Simooya Biology staff: Mr. H. Howie
13	Kafue Dry Secondary School, Box 1, Kafue	1.4.71	Evaluation of SSSPP Biology	Headmaster. Mr. S. Chicke Science staff. Mr. A. Waterson, Mr. A. Siwella, Mr. R. John, Mr. A.J. Carroll
14	Department of Wildlife Fisheries and National Parks, P.O. Box 1, Chilanga.	25.3.71	Discuss links with biology curriculum in secondary schools	Director: Dr. J. Clarke Deputy Director: Mr. Simpelwe Chief Research Officer: Dr. W.F. Ansell

	Name and Address of School or Institution	Dates	Purpose of Visit	Personnel Interviewed
15	Central Fisheries Institute, Box 100, Chilanga.	25.3.71	Discuss links with biology curriculum in secondary schools	Chief of Project FAO Fisheries Research: Dr. L. Jeenis Acting Senior Fisheries Research Officer: Dr. A.B. Maybaye Fisheries Biologists: Dr. A. Coche, Dr. E.K. Balon
16	Department of Agriculture Mount Makulu Research Station, Box 7, Chilanga.	25.3.71	Discuss links with biology curriculum in secondary schools	Deputy Director: Mr. P.C. Mukanda Senior Research Officer: Dr. J. Abington
17	Department of Agriculture Box 55, Lusaka.	26.3.71	Discuss links with biology curriculum in secondary schools	Chief Conservator of Natural Resources: Mr. P. Hall

IV. MALAWI

1	Biology Department Chancellor College, University of Malawi, P.O. Box 5097, Limbe.	3.4.71 and 24.4.71	Host office and centre for in-service training course. Lecture to students	See Appendix B
2	Ministry of Education, Private Bag 1, Limbe.	19.4.71 and 23.4.71	Discussions on future of Unesco Biology in Malawi	See Appendix B
3	Soche Hill Secondary School, Box 5692, Limbe.	5.4.71	Evaluation of Unesco Biology	Headmaster: Mr. E.D. Kadzombe Biology staff: Mr. A. Zoani
4	St. Patrick's Secondary School, Box 5450, Limbe.	6.4.71	Evaluation of Unesco Biology	Headmaster: Brother Aloysio Biology staff: Mr. B. Mkandawire
5	Chiradzulu Secondary School, Box 20, Chiradzulu.	7.4.71	Evaluation of Unesco Biology	Headmaster: Mr. A.E. Zimba Biology staff: Mr. D. Kayira
6	Malosa Secondary School, P.O., Kasupe.	8.4.71	Evaluation of Unesco Biology	Headmaster: Mr. L.A. Lees Biology staff: Mr. Z. Chirambo

	Name and Address of School or Institution	Dates	Purpose of Visit	Personnel Interviewed
7	Malawi Certificate of Education Examination Board, Box 5949, Limbe.	8.4.71	Discussions of examination administration for Malawi Certificate of Education	Director: Mr. R.W. Fiddes
8	Ministry of Finance External Aid Section, Box 53, Zomba.	22.4.71	Discussion of financial problems of Unesco Biology in Malawi	Finance Officer: Mr. Mayaya
9	United Nations Development Programme, Box 46, Zomba.	22.4.71	Discussion of findings of current mission	Acting Resident Representative. Mr. V. Furst
10	University of Malawi Soche Hill Teachers' Training College, Box 5496, Limbe.	22.4.71	Lecture to students on recent developments in Science teaching	Lecturer in Agricultural Education. Mr. J. Fletcher Lecturers in Biology: Mr. E. Mwasi Mr. G. Lenton
11	Regional Testing, Box 5759, Limbe.	23.4.71	Problems of examining Unesco Biology course	Deputy Director: Dr. R.T. Johnson

APPENDIX D

KENYA INSTITUTE OF EDUCATION BIOLOGY PANEL
MINUTES OF MEETING OF BIOLOGY PANEL HELD ON
SATURDAY, 20th FEBRUARY, 1971 AT K.I.E.

Present:

Dr. J.M. Waithaka, Chairman	University of Nairobi
Mr. J. Kimura, Secretary	K.I.E.
Dr. N. Erneholm	K.S.T.C.
Dr. S. Frank	K.I.E.
Mrs. A. Glover	Pangani Girls School
Mr. T. Malkin	Njiris School
Dr. G.R. Meyer	Unesco Consultant, Macquarie University, Sydney, Australia
Mrs. J. Muchoki	K.I.E.
Mr. P. Nderu	Ministry of Education
Dr. S. Nillson	Unesco Consultant
Mr. I. Omondi	Machakos High School
Mr. J.F. Omange	K.S.T.C.
Mr. D. Pinney	Thika High School
Mr. F.M. Wakhu	K.S.T.C.
Miss G. Wokabi	K.I.E.

Regrets:

Miss Evans

19/1 Introduction of Dr. G. Rex Meyer and Dr. N. Erneholm and new panel members Mr. Malkin, Mrs. Muchoki, Mr. Pinney, Miss Wokabi

19/2 Minutes of the meeting:

The minutes of the previous meeting were confirmed.

19/3 Matters arising:

a) SSP Examination: The East African Examination Council has called an international meeting for 27th February, 1971 in Nairobi at New Jogoo House to discuss a sample paper for SSP and to consider the position regarding practical examinations. The panel will be represented by Mr. Nderu, Dr. Frank and Mr. J. Hogg. The panel was requested to prepare sample questions for year 4. Dr. Meyer, Mr. Kimura, Dr. Frank and Mr. Hogg will do this.

b) SSP Feedback: Mr. Hogg and Mr. Kimura have prepared a questionnaire and a school visit committee is in the process of visiting all trial schools.

c) Dr. Meyer's Visit: Dr. Meyer arrived on 15th February, 1971 for one month in Kenya to assist the Biology Panel in SSP feedback, evaluation, teachers' guides, and to give in-service courses at various centres in Kenya to familiarise teachers with the discovery approach to teaching biology and new methods of designing examination questions.

d) SSP Co-ordinator: Mr. B.T. Chadwick has been appointed as co-ordinator in SSP Biology but has been attached to the Ministry of Education in Uganda. For this reason, Kenya and Tanzania feel this limits his effectiveness as a co-ordinator for all three countries. There is still a pressing need for a co-ordinator, either one person, or a representative from each country to form a co-ordinating committee, who would be attached to an international body like Unesco or East African Examination Council so all three countries could use him to co-ordinate feedback, give unit tests and examinations.

e) K.J.S.E. Alternate Examination: Although the Biology Panel teachers and students at trial schools had expected an alternate K.J.S.E. examination for SSP students in Form II, no examination materialised. A need exists for smoother communication with the Ministry of Education through K.I.E. and the Inspector of Biology. The Acting Chief Education Officer has written a circular to all secondary schools informing them that henceforth no K.J.S.E. examination will be given in Government schools at the end of Form II.

f) New Panel Members: Mr. Pinney, Mr. Malkin, Mrs. Muchoki and Miss Wokabi have been invited as new panel members and were in attendance. The need to invite someone from Alliance High School was expressed, and also to invite R.D. Stephensen to take the place of Mr. Hakau who has left for the USA for an extended period.

g) Draft Syllabus on Human and Social Biology: Discussion deferred to the next meeting to give panel members more time to study the syllabus, which was circulated from Cambridge as a suggested replacement for the present syllabus in Health Sciences.

h) Planned Parenthood: Varying viewpoints were expressed for introducting information on sex education and planned parenthood into the schools. The Panel must proceed cautiously to avoid being accused of producing something in the curriculum unofficially. Some guidance from the Ministry is needed to help teachers know how far to go. Further thought and discussion was recommended and the matter deferred until the next meeting.

j) Year III SSP Biology: Year III Vol. 2 has been sent from the Uganda Publishing Company and is en route. There is a shortage of Teachers' Guides for Year III and copies will be requested from Uganda. Additional copies of Year I have also been ordered from Tanzania.

19/4 Agenda:

a) Circulation of Year IV SSP Book: 5000 copies were printed - 900 have been sent to uganda and 1800 to Tanzania, at 7/65 per copy. In addition, all panel members, the East African Examinations Council, Uganda and Tanzania Panels, and institutions like the

University of Nairobi, K.S.T.C. Kenyatta College, Unesco, Museum, etc., have received copies. All trial schools in Kenya should receive copies though they will not be teaching Year IV until next year, as well as Kenya participants of the April workshop.

Comments on Book IV: The standard of production was thought to be better than previous volumes, though the cover should be brighter and some of the diagrams were thought to be too small.

b) Writing of Teachers' Guides: Teachers' Guides have been written for four of the six units with the help of Dr. Frank, Mr. Kimura, Mr. Omange, Mr. Nderu, Mrs. Glover and Mr. Malkin. Unit 5 will be prepared by Mr. Kimura and Unit 6 by Dr. Nillson.

A need was expressed for linking and co-ordinating material between units and greater emphasis on concepts.

c) Smaller Working Committee: There is a need for special committees and for urgent matters to be attended to by a small working committee. It was agreed that such committees would be formed as the need arises.

d) SSP Feedback: School visits will be linked with Dr. Meyer's visit. Dr. Meyer plans to visit a number of SSP trial schools with a K.I.E. team to interview the teacher, fill out the questionnaire, interview selected students, observe a class in session, and to administer a brief test (from Form I) to be given to all Forms without warning in an effort to test how successfully students have retained and understood material previously learned.

Lack of continuity of staff in trial schools was discussed as a continuing problem plaguing the success of SSP trials. It was suggested that Headmasters also be interviewed during school visits.

e) Dr. Meyer's Services: The most urgent matter for the Panel is the construction of sample questions from Book IV for the international meeting on 27th February, 1971. An intensive workshop for panel members was set up for Monday, 22nd February, where Dr. Meyer will discuss new techniques in preparing examinations and aid the panel in constructing questions. Those participating will be: Dr. Frank, Mrs. Glover, Mr. Kimura, Mr. Malkin, Mr. Omange, Mr. Pinney, Mr. Wakhu and Miss Wokabi. Dr. Meyer will also conduct in-service courses for biology teachers in the areas of Nakuru, Kisii, Kisumu, and Nairobi in addition to visiting a number of SSP trial schools in the Western and Rift Valley Provinces.

Chairman
Dr. Waithaka

Acting Panel Secretary
Dr. Frank

APPENDIX E

EAST AFRICAN EXAMINATION COUNCIL INTERNATIONAL SSP
BIOLOGY PANEL MEETING HELD AT THE KENYA INSTITUTE
OF EDUCATION NAIROBI, KENYA, SATURDAY, 27th FEBRUARY, 1971

Present:

East African Examinations Council
S. Omenge

Kenya
Dr. S. Frank
Mr. J. Hogg
Dr. Rex Meyer
Mr. P. Nderu

Tanzania
Mr. B. Chaplin
Mr. Lille
Mr. A. Meena

Uganda
B.T. Chedwick
T. MacPherson
T. Seddon

Regrets:

Mr. Joseph Kimura, Kenya Institute of Education

1. The meeting began at 9.00 a.m. Mr. A. Meena, Tanzania was elected chairman and Dr. S. Frank, Kenya, secretary

2. Minutes of last meeting were approved

3. Agenda:

i) Specimen examination paper

It was agreed that the specimen examination paper must follow the pattern of the actual paper. Since the chief examiners and moderators were the only ones who knew the form of the actual paper, they must produce the specimen paper from the banks of questions submitted by Kenya, Tanzania, and Uganda.

The specimen paper will be a complete paper and can guide the chief examiner since the actual paper has not yet been finally set. The specimen paper is not confidential and should be made available to all students and teachers involved in SSP Biology.

The specimen paper was promised on or before March 15, 1971 and the East African Examinations Council will circulate it to the three countries.

Uganda and Tanzania require a mock examination but this is a national matter and not for the East African Examinations Council. It was agreed that Tanzania and Uganda would get together to produce a specimen paper for the mock examinations which would be different from the specimen paper.

Mr. Omenge announced the form of the paper and the draft timetable:

Paper I : Objective questions. Time allotted 2½ hours.
Draft timetable - Wednesday, 24th November, 1971 in the afternoon

Paper II : Essay questions. Time allotted 1½ hours.
Draft timetable - Tuesday, 30th November, 1971

ii) Practical examination

There would be no practical but questions in both Parts I and II would include those which test practical skills. The Cambridge Syndicate has been notified of this decision but because of the postal strike in U.K. no response from the Syndicate has been received. In the event that Cambridge objected to this decision, an emergency meeting of the Ministers of Education from the three countries would be called.

It was suggested that special consideration be given to students who joined SSP late or who were shifted around or for some other reason did not complete the total 4 years. An estimate from the school of each pupil's mark would provide a check on the results of the final examination. This information would be passed to the inspectors and then to the Council. The Council will debate this point with the Secretaries.

A need for evaluation of the results of the examination was expressed, both mock and actual, and Mr. Omenge agreed to this. Although the scripts of the examination cannot be passed on for evaluation, the names and grades could. A list of the rank order of students from schools would aid in this evaluation and it was agreed that the schools, through the inspectors would submit these lists to the Council.

iii) Completion of course

The Council has requested information from the three Ministries concerning how far the trial schools have gone in completing the course to aid the examiners in constructing the examination. There is still time to alter the examination if this information were at hand. This information, however, is not easily available. It was agreed that the examination should be designed to cover the entire course and that marks should later be adjusted so that the Pass rate and the Grading rate would be similar to traditional Biology.

The following sentence should appear on the first sheet of the examination and supervisors should read this to the candidates before the examination:

"Candidates should answer as many questions as possible even if the material appears unfamiliar."

Tanzania agreed to notify the other countries as quickly as possible which portions of Years I and II could be considered optional and therefore not examinable. There is no time to do this for the present examination, but would help in future in cutting down the length of the examinable portions of the course.

The 1972 syllabus is already out and is identical with that of 1971. However, the 1973 syllabus will be out in November 1971 so there is time to alter it between now and October 1971. It was agreed that each country would label which 20% of its books could be considered as optional.

Many schools are apparently not receiving the syllabus, either for traditional or SSP Biology. The Council sends these to the Ministries and the Ministries to the schools. If schools do not receive them, they can write to the Council requesting copies provided they do so through the Examinations Section of their respective Ministry.

4. Any other business:

i) Revision of Years I and II

Tanzania is planning to hold a workshop in late June 1971 to revise Books I and II. Three delegates from each country should plan to attend. This will be considered an interim revision since insufficient feedback will be available for revision of all four books.

ii) Duplication of Books

Mr. MacPherson suggested that in view of delays encountered in receiving copies of books from other countries that each country be allowed to duplicate or print its own copies from a master copy. It was agreed that as a temporary measure, each country could duplicate extra copies if it wished, but that no alterations be made without following the appropriate procedures involving all three countries. Any suggestions for alterations would be considered as feedback.

iii) Marking Place

A request was made by Mr. Hogg for rotating the marking place from Kampala to other centres. Mr. Omenge announced that the July training and December marking sessions would take place in Kampala this year as in the past.

The meeting adjourned at 12.45 p.m.

Mr. A. Meena
Chairman

Dr. S. Frank
Secretary

APPENDIX F

REPORT ON VISIT TO DAR-ES-SALAAM FOR CONSULTATIONS WITH MINISTRY OF EDUCATION, SSP PANEL MEMBERS AND UNIVERSITY STAFF ON SSP BIOLOGY, CHEMISTRY AND PHYSICS IN TANZANIA
14th - 16th MARCH, 1971

by

G.R. Meyer
Unesco Consultant

PROGRAMME

Sunday, 14th March

9.30 am Arrive Dar-es-Salaam. Met by Miss A. McCusker, Botany Department, University of Dar-es-Salaam and member of SSP Biology Panel.

10.30 am - 12 noon At residence of Mr. B. Chaplin of SSP Biology Panel. Discussions with Mr. Chaplin and Miss McCusker on SSP Biology. The following points were made:

i) Unit tests for Book II (second form) are still in production;
ii) regular meetings of panel held since May 1970 considered a programme for the summative evaluation of SSP Biology and a research proposal was submitted to the Ministry of Education in December 1970;
iii) SSP Biology is popular with pupils and is being successfully taught in trial schools;
iv) many schools in Tanzania have expressed interest in the programme and wish to begin teaching the new course.

12.30 pm Telephone conversation with Mr. F.I. Ajumogobia, Unesco, Chief of Mission to arrange appointments at Ministry of Education for Tuesday, 16th March.

Monday, 15th March

7.30 am - 9.30 am Meeting with Mr. A. Meena, Secretary of SSP Biology Panel, Institute of Education, Dar-es-Salaam. Mr. Meena re-emphasised the points mentioned by Miss McCusker and Mr. Chaplin and raised the further problem of co-ordinating the final revision of the books and teachers' guides for years 1 to 4. Mr. Meena suggested that a co-ordination committee be established consisting of two or three panel members from each of Kenya, Tanzania and Uganda. He did not believe there was a place now for a single co-ordinator and that final revision would best be undertaken by committee.

Tanzania would prefer to see the final revision of the course in 1972 but notes the special problem of Kenya which needs 1972 to have a first trial of the fourth form materials. This problem still to be resolved.

Mr. Meena raised two problems:

i) SSP teachers would sometimes be transferred from trial schools leaving inexperienced teachers untrained in the special methods of SSP to continue with the new programme. He had requested the Ministry to try to reduce the number of such transfers.
ii) There was need to mount more intensive programmes of in-service training similar to courses given by Meena and Meyer, April to July 1970.

The Tanzanian Ministry of Education would wish soon to assess the final outcome of the SSP experimental programme and make a decision whether or not to introduce SSP Biology into all schools in 1972 or 1973.

9.30 am - 10.00 am Discussion with Mr. A.A. Lema (Director, Institute of Education) and Mr. A. Meena. Mr. Lema requested information on acceptability of SSP Biology in Kenya. A summary of a small evaluation study undertaken in Kenya during the previous month was discussed. Mr. Lema and Mr. Meena were pleased to know of the positive findings of the study. These included:

i) Concepts taught in Form 1 were retained and understood in Forms 2 and 3;
ii) pupils were very interested in SSP Biology and had good attitudes towards it;
iii) teachers of SSP Biology generally underestimated pupils achievement and,
iv) the course was successful in a wide variety of educational settings.

Mr. Lema expressed the hope that similar research could be undertaken in Tanzania to assist the Ministry in its decisions on the future place of the course in the curriculum.

10.00 am - 12 noon Meeting with Mr. J. Kent and Mr. J. Pendaeli of SSP Chemistry Panel to consider present problems and future developments in SSP Chemistry in Tanzania. Kent and Pendaeli requested advice on:

i) Evaluation of SSP chemistry and,
ii) final revision and presentation of the materials.

They stressed that the Ministry of Education would soon seek advice on whether or not to introduce the new course and there was only scattered and relatively unsystematic evaluative data available to assist in their decision. Mr. Pendaeli was especially concerned about the absence of a single textbook since the presentation of individual pupil sheets, tests, teachers' guides, readers, etc. could make it difficult for the Ministry and others to review the overall programme.

After considerable discussion it was recommended that the following procedures be adopted:

i) A small evaluation study be mounted immediately in selected trial schools. Techniques to be used to include interviews with teachers and school principals, completion of a questionnaire by SSP chemistry teacher, administration of standardised achievement test to all forms, preparation by pupils of written statements

on their reactions to the course and observations of school resources. A final assessment of the acceptability of the course could then be made.

ii) The materials at present produced, to become the basis of a textbook. Pupil sheets to be arranged in units, each unit to be concluded by a unit test. Each pupil sheet or group of sheets to be prefaced by text extracted from readers, related texts, teachers' guides and other sources.

iii) Recommendations for revision be presented in the form of a flow chart consisting of national aims → course objectives → concepts to be developed → teaching strategies to be used → facts to be established. Some sort of continuous mechanism of feedback and revision to be implemented with the introduction of the new course.

Finally problems of the SSP Chemistry examinations were considered. The difficulties of pre-testing objective items were reviewed and it was recommended that the policy of the East African Examination Council of appointing an examiner and two anonymous moderators be abandoned. It was agreed that the Council should be asked to make use of committees to discuss questions directly with the examiner. This would be a reasonable substitute for pre-testing questions.

8.00 pm - 9.00 pm Discussions with Dr. G. Duncan, Unesco Project Manager and Mr. J. Kent on SSP Science curriculum aspect of the Unesco Science Teaching Project in Tanzania. The urgency of finalising the trial editions was stressed. It was recommended that intensive work be undertaken to complete the curriculum work in Biology, Chemistry and Physics and to produce reports for the Ministry on the overall effectiveness of the programme. Mr. J. Kent would need to be relieved of duties such as lecturing at University and the supervision of teaching practise if these important goals are to be achieved.

Tuesday, 16th March

9.00 am - 9.30 am Discussion with Mr. F.I. Ajumogobia, Unesco on background of SSP Science projects in Tanzania. The difficulties of developing programmes of science stressing discovery learning were discussed.

10.00 am - 11.00 am Discussion with Mr R.S. Seme, Assistant Director in charge of Curriculum, Ministry of National Education. Mr Seme expressed grave personal doubts about the future of the SSP Science courses in Tanzania, mainly on the grounds that they did not necessarily accurately reflect the national objectives. He was especially critical of SSP Physics, less critical of SSP Chemistry and least critical of SSP Biology. The Biology course still in his opinion failed to meet national objectives but appeared to be a well organised programme. Mr. Seme was also critical of the design of the experiment to try out the new courses in Tanzania. He criticised the earlier Ministry decisions to have trial schools widely scattered throughout the country. This criticism was based on the difficulty experienced in obtaining feedback.

Mr. Seme had no alternative proposals to make in the event of the Ministry rejecting SSP Science, but stressed that any decisions on the future

of SSP or any alternative programme must await reports on the evaluation of the SSP courses. It was agreed, therefore, the Biology, Chemistry and Physics Panels be encouraged over the next few months to complete evaluation studies of their programmes and to submit to the Ministry as soon as possible, sets of their materials, together with the detailed reports of their suitability and effectiveness.

11.00 am - 11.45 am Discussions with Mr. M.G. Kayuze, Secretary General Tanzania Unesco National Commission at the Ministry of National Education. Mr. Kayuze said that he had received and distributed copies of the report on the mission of April/July 1970 and commented that the work done at that time had been of considerable value. He discussed in general terms some of the problems associated with the evaluation of new curricula, and stressed the need for more of this work in developing countries.

Mr. Kayuze expressed considerable sympathy for the type of approach adopted by the SSP programme but appreciated the problem of relating new programmes to national objectives.

11.45 am - 12.15 pm Discussion with R. Kiyao, member of the SSP Physics Panel, and assistant to Mr. R.S. Seme, Ministry of National Education. Mr. Kiyao expressed some dissatisfaction with SSP Physics. He agreed that it was probably a better course than the one currently leading to the Cambridge O-level examinations, but that it had not sufficiently considered the resources available in Tanzanian schools or the objectives of education in Tanzania.

Wednesday, 17th March

8.00 am - 8.30 am Discussions with Professor Samaan, Faculty of Education, University of Dar-es-Salaam on a Ph.D. research proposal submitted by Mr. A. Meena, Secretary of the SSP Biology Panel. Mr. Meena proposed a study of the effectiveness of SSP Biology in Tanzania and after discussions Professor Samaan asked about the possibility of obtaining Unesco post-graduate fellowships for four members of Faculty or Institute staff who had expressed a desire to undertake post-graduate research to evaluate SSP Biology, Chemistry and Physics. It was explained that I could do no more than draw attention of Unesco to this request.

12 noon Depart Dar-es-Salaam for Lusaka.

APPENDIX G

REPORTS OF THREE EVALUATION STUDIES OF BIOLOGY CURRICULA IN KENYA, ZAMBIA, MALAWI USING TECHNIQUES RECOMMENDED BY G.R. MEYER FEBRUARY TO APRIL 1971

I. Preliminary evaluation of the effectiveness of SSP Biology in a sample of experimental schools in Kenya, 22nd March, 1971

by J. Kimura
S. Frank
R. Meyer

II. Preliminary evaluation of SSSPP Biology in the SSSPP schools in Zambia, April 1971

by J.W. Barks
J.V. Huxley
R. Meyer

III. Preliminary evaluation of Unesco Biology for Forms I and II in four of five trial schools in Malawi, April 1971

by R. Meyer
S. Moss
M. Reed

I. PRELIMINARY EVALUATION OF THE EFFECTIVENESS OF SSP BIOLOGY IN A SAMPLE OF EXPERIMENTAL SCHOOLS IN KENYA

A Report by: J. Kimura — Co-ordinator, Curriculum and Development, Kenya Institute of Education

S. Frank — Acting Secretary, Biology Panel, Kenya Institute of Education

R. Meyer — Unesco Consultant, Director, Centre for Advancement of Teaching, Macquarie University, Sydney, Australia

SUMMARY ABSTRACT

In March 1971 three curriculum workers from the Kenya Institute of Ecuation visited five secondary schools in the Rift Valley and Western Provinces of Kenya. Their purpose was to conduct a preliminary evaluation of SSP Biology (School Science Project), an experimental programme which had been in progress since 1968 in Forms I through III. These schools were representative of the seventeen secondary schools in Kenya involved in the trial of this programme.

SSP Biology aims at altering traditional teaching in three main ways:

i) Content made relevant to life in general and East Africa in particular;
ii) use of the discovery approach to learning rather than rote memorization;
iii) emphasis on major concepts rather than on large numbers of minute isolated facts.

At each school, the KIE team followed these procedures:

i) A representative class from each of Forms I to III was given a short multiple-choice achievement test on a specified unit from Book I Volume I. The school had no advance notice of this test;
ii) each pupil was asked to write a short statement on what he liked and disliked about this biology course;
iii) the school principal and biology teacher were interviewed and where possible the laboratories, school grounds and resources such as equipment, library, reference books, facilities for extra-curricular work and the presence or absence of improvised equipment were appraised.

The following generalizations summarise the main points which emerged:

I. Achievement Test

1. All forms showed excellent retention and understanding of material taught in Form I.

2. Upper forms showed a definite trend toward deeper understanding of more difficult concepts.

3. The achievement performance of pupils from five different schools could not be correlated with whether the teacher was African or not, whether the headmaster was African or not, whether the students were boys or girls, or whether the school was well equipped or not. This suggests that SSP Biology is suited to a wide variety of educational situations.

II. Pupil Comments

1. There is a high degree of acceptance and enthusiasm for SSP Biology on the part of pupils.

2. Form III students showed a significant gain in their appreciation of the objectives of SSP Biology as compared with Forms I and II.

3. Criticism of SSP centred around frustrations due to lack of equipment, lack of success in performing experiments and desire for more written material for study rather than basic objections to the philosophy or content of the course.

III. Teacher and Headmaster Interviews

1. Although teachers accept the philosophy of SSP they underestimate their pupils and themselves in achieving the objectives of the course.

2. Teachers are severely burdened by lack of equipment and lack of time in completing SSP material.

3. A great need for microscopes exists in all schools.

On the whole, the findings of this preliminary evaluation have been encouraging. While there are problems associated with the programme, the authors have made recommendations for overcoming them. The authors are confident that further evaluation of SSP Biology at the conclusion of Form IV will strengthen the provisional conclusion of this study, namely that SSP Biology is highly appropriate for all pupils in Forms I to IV in Kenyan secondary schools.

INTRODUCTION

As part of a worldwide movement to change drastically the teaching of science, East Africa introduced the School Science Project (SSP) in 1968 into selected secondary schools in Kenya, Uganda, Tanzania for the teaching of Biology, Chemistry and Physics. The new project aimed at altering the traditional teaching in three main ways:

i) Content made relevant to life in general and East Africa in particular;

ii) use of the discovery approach to learning rather than rote memorization;
iii) emphasis on major concepts rather than on large numbers of minute isolated facts.

SSP Biology materials have now been produced in trial edition for Year I to IV and are at present being used in Forms I to III in seventeen experimental government secondary schools in Kenya.

In March 1971 three curriculum workers from the Kenya Institute of Education visited five of the seventeen trial schools for preliminary evaluation of the programme. They aimed to assess the effectiveness of the programme in:

i) The development of understanding of key biological concepts;
ii) acceptability and effectiveness of the discovery approach adopted in the course;
iii) the relevance of content;
iv) the level of difficulty of the programme;
v) attitudes of pupils and teachers towards the new course;
vi) problems associated with the teaching of specified units and any administrative or other difficulties associated with the programme.

They hoped to reach tentative conclusions about the suitability of the course for all secondary pupils in Kenya.

The five schools visited were representative of the range of ability of African O-level pupils in Kenyan government schools. Two girls schools and three boys schools were included in the sample.

At each school the procedures followed were:

i) A representative class from each of Forms I to III was given a short multiple-choice achievement test on a specified unit from Book I Volume I. The school had had no advance notice of this test. The test is included in this report as Attachment I;
ii) each pupil was asked to write a short statement on what he liked and disliked about this biology course;
iii) the school principal and the biology teacher were interviewed about the acceptability of the new programme and especially about specific problems and difficulties involved in the teaching. This interview was based on a questionnaire that had been sent to the school some weeks previously. See Attachment II;
iv) the facilities for teaching biology in classrooms, laboratories and school grounds were observed;
v) shortly after leaving the school the committee assessed evidence from tests, essays, questionnaires, interviews and observations, and used this to obtain ratings for various criteria of acceptability of the new course.

I. ACHIEVEMENT TEST

A standardised test of ten only multiple choice questions was administered to Forms I, II and III in each of the five experimental schools visited. The test was designed to assess achievement of a variety of mental skills and concepts on a unit of material taught in Form I. (For more details see Table II). The main question to be answered was: Did the upper forms retain knowledge and understanding of concepts learned in Form I?

The frequencies of scores and the mean scores obtained by Forms I, II and III in the five schools are given in Table I.

Table 1

Results of SSP Achievement Test Frequency Distribution
(Total of Five Schools)

Score	1st Form	2nd Form	3rd Form
10	0	0	0
9	3	1	0
8	3	6	11
7	18	24	24
6	35	34	41
5	50	42	50
4	32	40	29
3	27	22	16
2	18	11	5
1	0	0	0
0	0	0	0
N =	186	180	176
Means =	4.74	4.93	5.26
Std. Dev. =	1.61	1.55	1.43

Analysis showed no significant differences between means.

Performance on Individual Questions

The performance on individual questions and the skills and concepts involved are given in Table II for each form:

Table II

Summary of Performance of Individual Questions
(Total of Five Schools) All Forms

Item	Mental Skill (cf. Bloom)	Biological Concept	Percentage Correct Response Form I	Form II	Form III
1	Knowledge	Keys are useful for the identification of organisms	62%	81%	86%
2	Analysis	Classification as a process of value in biology	52%	51%	57%
3	Comprehension	Use of a pie chart involving numbers of various types of animals	21%	10%	12%
4	Evaluation	Suitability of given scientific names for a described organism	41%	34%	48%
5	Application	Interpretation of growth of known plants under experimental conditions	52%	52%	54%
6	Application	Use of biological keys to identify given organism	44%	45%	49%
7	Evaluation	Selection of the most appropriate characteristic for classification	30%	24%	29%
8	Evaluation	Suitability of words to describe morphology of leaves	77%	71%	72%
9	Application	Use of group characteristics to classify specified organisms	62%	58%	63%
10	Evaluation	Selection of most appropriate characteristic to give least variable measurements	34%	50%	63%

Differences Between Schools

The mean achievement scores by schools are shown in Table III. The table also gives information about the teachers, headmasters and the quality of laboratory facilities.

Table III

Mean Achievement Scores of Sample Schools

School (in rank order on achievement test)	Form I	Form II	Form III	SSP Biology Teacher Citizenship	Graduate	Headmaster	Pupils	Quality of Laboratory Facilities
1	4.6	5.3	6.0	Only African	Yes	African	Boys	Excellent
2	5.2	5.1	5.4	" African	No	Asian	Girls	Poor
3	4.4	5.2	5.4	" Expatriate	Yes	Expatriate	Boys	Good
4	4.4	5.0	5.0	" African	Yes	African	Boys	Good
5	5.1	4.2	4.5	" Expatriate	Yes	Expatriate	Girls	Good

From the results shown in the three tables, the following generalizations are offered:

i) The test showed excellent retention and understanding of material taught in Form I through all forms;

ii) while there was no significant difference in the overall performance from form to form, analysis of individual questions showed a trend toward deeper understanding of more difficult concepts in the upper forms. (Questions 1, 2, 4, 6 and 10);

iii) comparing different schools, it appeared that whether the teacher was African or not, whether the headmaster was African or not, whether the students were boys or girls, and whether the school was well equipped or not did not seem to influence significantly the achievement on a selected unit of SSP Biology. If this can be substantiated with more data in the future, it suggests that SSP Biology is suited to a wide variety of educational situations.

II. PUPIL COMMENTS

All pupils tested were also asked to write a short statement on what they liked and what they did not like about SSP Biology. Their comments are summarised in Table IV:

Table IV

Frequency of Comments Mentioned by SSP Biology Students
(Total Sample = 439)

A. Aspects Most Liked

		Form I	Form II	Form III	Average All Forms
1	Practical work	12%	36%	64%	40%
2	Interest in plants and animals	53%	17%	22%	29%
3	Relevance to life	25%	11%	47%	28%
4	Ease of remembering and understanding	5%	21%	29%	20%
5	Discovery approach-independent thinking	5%	16%	22%	16%
6	Field work	3%	8%	14%	9%

B. Aspects Least Liked

1	Not enough equipment	0%	5%	21%	10%
2	Lack of success in performing experiments	1%	2%	23%	10%
3	Pupils books difficult or lacking	3%	2%	21%	9%
4	Need for supplementary notes or books	1%	6%	13%	7%
5	Not enough time for work	1%	2%	12%	5%
6	Practical work	1%	2%	12%	5%
7	Having to think for oneself	1%	2%	5%	3%

A. Aspects Most Liked

More Form I students mentioned their interest in plants and animals than students in higher forms. But in all other categories, upper form students showed a significant gain in their appreciation of the objectives of SSP Biology as compared with Form I students, i.e. practical and field work, relevance to life, ease of remembering and understanding the material, and use of the discovery approach and independent thinking.

Following are some quotes from pupils to show sample statements and how they were classified:

1. Practical Work

I do like practical because I see with my own eyes whether the experiment is true or not.

I like doing things practically not as the old one just sitting learning then leaving it like that.

When we began this biology course at first I thought it was a waste of time but later I found it very interesting especially the way we prove things by ourselves as young biologists without relying on written theories.

After being given the procedure, I can exactly see what happens instead of being taught as a lesson that this and this happens.

2. Interest in Plants and Animals

I like the course because I study about living things which I know and which I don't know.

It teaches me that there are very many kinds of plants and how they behave and how they get their own food.

I like the course because it teaches me many things about plants and animals.

3. Relevance to Life

I like SSP Biology because it deals with the obvious things I always see, hear and touch

I would like to be a biologist in future because I like agricultural work.

It seems to be leading to the foundation of one's life.

I want to know and study living things because I will be able to be a doctor and help my friends who are sick.

This course helps a great deal the students who might be farmers in the near future and for girls to keep their children in good health.

It teaches us things which will help us not only in the exams but also for our daily life.

Sometimes I practically apply the new methods I learn at home on the farm.

4. Ease of Remembering and Understanding

We do not have to memorise a lot but have an idea of what we are doing.

This practical work is unforgettable.

It is taught in such a way that I understand it best.

Once we do an experiment I can't forget it.

Although I am still in Form III, but when I see a Form IV student who is learning an old biology course, a very simple question from my course he cannot answer but I can try to answer a question from his course.

It is much easier than other biology and it gives more strength in thinking.

5. Discovery Approach - Independent Thinking

When I make observations it really makes me think.

I like SSP Biology because I can be one of the scientists.

The goodness of SSP is that it makes you think for yourself before you discover something.

We learn more than any other people who had not seen this type of biology.

It gives me a lot of thinking and sets my brain to work.

SSP Biology makes us to think and to get something from our heads.

6. Field Work

It is very interesting when I got out with a net catching different kinds of insects.

I like it because you examine an animal or plant in its habitat and you learn it.

I would like to know more about insect pests.

You will know where the animal lives and maybe the animal is harmful then you will avoid it.

B. Aspects Least Liked

Form III students expressed more dislike of the course than students in other forms. In general their comments showed frustration at not being able to learn more, lack of equipment, lack of enough time for work, need for supplementary notes, and lack of success in performing experiments.

Following are sample quotes and how they were classified:

1. Not Enough Equipment

Our school is so poor that we can't afford buying all the necessary apparatus so we don't carry out all the experiments. Some are left undone and then we conclude nothing.

It is difficult mostly when you don't have enough apparatus for the experiments.

There is no apparatus for doing all the experiments which are said in the book.

Most of the things or equipment for the experiments are not found here in our school and it is very hard for us to leave some of the experiments.

2. Lack of Success in Performing Experiments

Sometimes I do the experiment then it becomes wrong then it seems that I have failed in everything because I don't find the right answer.

I may find all what I believe to be right to be wrong.

The only thing which I dislike is the experiment itself. This gives me a bit of confusion in that sometimes I confuse the results.

When doing experiments there are some units I din't actually follow.

I don't like it because in dry season to get an organism for study is very hard, e.g. the eff of a butterfly.

3. Pupil Books Difficult or Lacking

Most of the time we are given a lot of questions to answer but with no answers.

I dislike the text book. Sometimes you find it hard to understand when you try to read and make some notes.

Some things are not well explained. The ones not explained in detail are hard for someone to know what is meant.

There are very few questions, no conclusions in some experiments and no summaries after any unit. I wish there could be summaries and summary questions too.

4. Need of Supplementary Notes or Books

There are no notes given unless one tries hard and when the exam is set they don't bring what we have learned.

The books we are using now don't show more information. I think it would be better if more notes were added.

The book does not give satisfactory information so we sometimes have to hunt for other books.

There are no notes in the book to help you when reading.

5. Not Enough Time for Work

More periods should be added - not enough time.

Too much time is spent outside the laboratory and hence the lessons become abominable.

It needs patience, long waiting till you use the result of your work.

This sort of course is nice but it is too slow, e.g. when you are learning about something like an ant you might take a week. You also go deep to study any simple thing which can take two weeks. So this is a waste of time.

The slowness of teaching. Not finishing experiments.

6. Practical Work

There is too much practical work that a year is hardly enough for us to cover all the work properly.

I find it very boring to stay out of class looking for unseen things like lizards, weaver birds, etc.

I dislike outdoor lessons because I hate being burned by the sun.

Most of our time we spent on observing animals and I don't grasp anything from that because we do it just by ourselves without reading textbooks.

Sometimes it is just very boring and some experiments are rather childish.

7. Having to Think for Oneself

Sometimes we have to think by ourselves a lot without any help from the teacher.

What I dislike is that I have to do a lot of thinking most of the time and I might sometimes write down the wrong ideas.

Sometimes they can give you a very short hint, but you can find yourself that you don't actually understand the whole thing.

The worst thing is that as we go ahead with practicals we feel alright but there are certain stages where I can go astray.

From the summary of pupil comments in Table IV the following points emerge:

i) Many more students commented favourably on SSP Biology than unfavourably;

ii) strong acceptance of the basic objectives of SSP was evidenced, particularly in Form III students;

iii) appreciation of the course increased significantly with exposure reaching a peak in Form III students;

iv) criticisms of SSP centred around frustrations due to lack of equipment, lack of success in performing experiments and desire for more written material for study rather than basic objections to the philosophy or content of the course.

III. Headmaster and Teacher Interviews and Observations of School Resources

During the interviews, headmasters and teachers were encouraged to describe their difficulties, dissatisfactions, objections and feelings of coping with the new course. Often useful comments were offered without being solicited. Whenever possible the laboratories were visited and qualities of rooms and equipment noted. The suitability of the school grounds for teaching biology was appraised. Resources such as library, reference books, facilities for extra-curricular work and the presence or absence of improvised equipment were checked.

All of these data have been used in arriving at an evaluation of the school's resources as excellent, good or poor. Results are summarised in Table V.

Although this table is based on fairly subjective judgments, the three curriculum workers arrived at their judgments independently. They found that in most cases they corraborated each other. Where there were minor discrepancies, discussions led to compromise ratings. But the observers were gratified to find that there was a high level of agreement.

The schools are designated 1 to 5 and are arranged in rank order of achievement of pupils in the multiple choice unit test.

Table V

Resources in the SSP School

School (in rank order on achievement test)	1	2	3	4	5
A. Technical					
1 Adequacy of school grounds	Excellent	Good	Good	Good	Good
2 Glassware and other basic apparatus	Good	Poor	Good	Good	Good
3 Specialised apparatus e.g. microscopes	Good	Poor	Poor	Poor	Poor
4 Laboratory space	Good	Poor	Good	Poor	Good
5 Equipment innovations	Poor	Poor	Good	Good	Poor
6 Extracurricular enrichment	Poor	Poor	Good	Good	Poor
B. Staff					
1 Academic qualifications	Good	Poor	Good	Good	Poor
2 Attitudes toward SSP	Excellent	Good	Good	Poor	Poor
3 Feeling of adequacy	Poor	Poor	Poor	Poor	Poor
4 Success in implementing SSP philosophy	Good	Poor	Poor	Poor	Poor

The clearest points to emerge from Table V are:

i) Where the teacher expressed a negative attitude toward SSP Biology (as in schools 4 and 5) the performance of the students was lower;

ii) whether the school was well equipped or not did not appear to influence pupil performance (school 1 was well equipped while school 2 was poorly equipped);

iii) all teachers expressed poor feelings of adequacy in teaching SSP;

iv) there was a great need for microscopes;

v) teachers underestimated their success in implementing the philosophy of SSP.

IV. Summary Evaluation

Using all available information from tests, essays, questionnaires, interviews and observations, the committee attempted to summarise its findings by assigning ratings on a scale from 0 to 100% for various criteria of acceptability of the new course. The rating scale kept in mind the following:

%	
0 - 20	Ineffective and generally unacceptable. Remedial action possible but difficult.
21 - 40	Unsatisfactory but remedial action relatively straightforward.
41 - 60	Minimum levels of acceptability and effectiveness but improvement predicated.
61 - 80	Satisfactory but further improvement recommended.
81 - 100	Most effective and acceptable.

Table VI

Effectiveness of SSP Biology

	Teacher Ratings (as they see their effectiveness)	Pupil Ratings (as achieved)
1 Understanding basic concepts	30%	50%
2 Discovery approach		
a) Acceptance	30%	75%
b) Effectiveness	20%	60%
3 Content relevance	50%	70%
4 Easiness of material	30%	50%
5 Attitudes toward		
a) Philosophy	70%	70%
b) Achievement	35%	70%
6 Problems		
a) Equipment	20%	20%
b) Improvisation	25%	10%
c) Adaptability to new course	35%	60%
d) Suitability of teachers	50%	

The following generalisations summarised the main points which have emerged from this preliminary evaluation of the effectiveness of SSP Biology:

I. Achievement Test

1. All forms showed excellent retention and understanding of material taught in Form I.

2. Upper forms showed a trend toward deeper understanding of more difficult concepts.

3. The achievement performance of pupils from five different schools could not be correlated with whether the teacher was African or not, whether the headmaster was African or not, whether the students were boys or girls or whether the school was well equipped or not. This suggests that SSP Biology is suited to a wide variety of educational situations.

II. Pupil Comments

1. There is a high degree of acceptance and enthusiasm for SSP Biology on the part of pupils.

2. Form III students showed a significant gain in their appreciation of the objectives of SSP Biology as compared with Forms I and II.

3. Criticisms of SSP centred around frustrations due to lack of equipment, lack of success in performing experiments and desire for more written material for study rather than basic objections to the philosophy or content of the course.

III. Teacher and Headmaster Interviews

1. Although teachers accept the philosophy of SSP they underestimate their pupils and themselves in achieving the objectives of the course.

2. Teachers are severely burdened by lack of equipment and lack of time in completing SSP material.

3. A great need for microscopes exists in all schools.

IV. Suggestions for Future Action

As an outcome of this study certain next steps can be pin-pointed and are strongly recommended for future action:

1. In-service courses to help the teacher cope with the SSP course.

2. Action to alleviate present shortage of equipment, particularly microscopes.

3. More testing of pupils on all units of the course to help both teacher and pupil identify where weaknesses and strengths exist in understanding basic concepts.

4. More supplementary reading material for pupils.

Summary Statement

On the whole the findings of this preliminary evaluation have been encouraging. While there are problems associated with the programme, the authors have made recommendations for overcoming them. The overall success of the course, however, is demonstrated by its acceptability in a wide variety of educational environments and by its relevance, as seen by pupils, to life after school. It seems an appropriate course for young men and women who are to contribute to the national development of Kenya. The authors are confident that further evaluation of SSP Biology at the conclusion of Form IV will strengthen the provisional conclusion of this study, namely that SSP Biology is highly appropriate for all pupils in Forms I to IV in Kenyan secondary schools.

SSP Biology

Questionnaire

1. Purpose: The purpose of this questionnaire is to collect data relating to staff, content of the course and equipment and material. We hope the data will help us to carry out final revision of SSP Biology years 1 - 4 and at the same time help us to plan for future in-service courses. Your co-operation will be greatly appreciated.

A member of KIE Biology Panel will be visiting your school sometime next term to exchange ideas with you. I hope you will have filled this questionnaire by then. The Biology Panel member will discuss this questionnaire with you and as such I am kindly asking you to retain it. You are at liberty to include other comments, suggestions and criticisms regarding SSP in the last column.

2. Staff: (Section B to be completed separately by all teachers teaching SSP Biology)

A i) Name of school
ii) Has the school had any difficulty in obtaining suitable biology teachers. Yes/No
If yes how was the problem solved?

B i) Name of SSP teacher
ii) Qualification S1/graduate
iii) Citizen/non citizen
iv) Non-citizen contract ends
v) I intend/do not intend to renew contract
vi) I have taught biology for years
vii) I have taught SSP Biology for years
viii) I have taught BSCS/Nuffield Biology for years
ix) Number of SSP courses attended

3. SSP Biology Course:

a) How many sets are doing SSP Biology in
   year 1 number of students
   year 2 number of students
   year 3 number of students
b) The school will enter students for 1972 E.A.C.E.
c) Do you have difficulty in setting objective tests for terminal examinations. Yes/No
d) Would you prefer a centrally set paper at the end of each year. Yes/No
e) Are you satisfied with
   i) Pupils text. Yes/No
      If No give reasons
   ii) Teachers' Guides. Yes/No
      If No give reasons
f) Are you satisfied with sequence of the content. Yes/No
   If No how would you prefer the sequence to be in
   i) Year 1
   ii) Year 2
g) What improvements would you suggest be done in the course in general.
h) Which units did you complete in
   i) Year 1
   ii) Year 2
i) To the best of your judgment which units do you think could be covered in
   i) Year 1
   ii) Year 2
j) Which units did you carry over from
   i) Year 1 to year 2
   ii) Year 2 to year 3
k) Which units in year 1 would you recommend be
   i) Drastically modified
      Give reasons
   ii) Be deleted from the course
      Give reasons
l) Which units in year 2 would you recommend be
   i) Drastically modified
      Give reasons
   ii) Be deleted from the course
      Give reasons
m) What other biology texts do your students use as supplementary reading material
n) What other biology text do you use as teachers reference
o) Would you teach SSP Biology comfortably without the accompanying Teachers' Guide. Yes/No

4. Equipment and Materials:

a) What equipment and materials have you found difficult to obtain or improvise.

b) Approximate annual expenditure in
   i) SSP Biology
   ii) All Biology
c) Any plans for the purchase of special SSP Biology equipment or materials
d) Any difficulties in obtaining equipment, chemicals and materials.
e) How many
   i) Biology labs do you have
   ii) Other labs used for biology teaching
f) Is the lab space adequate. Yes/No
   If No give details of how you overcame this problem.
g) Is there a lab assistant in your school. Yes/No
   If Yes is he/she trained. Yes/No
h) Any other comments on SSP Biology.

J.D. Kimura,
Secretary Biology Panel

Biology Test and Answer Sheet
(see pages 92-96)

Ref. No. 15/2/12

Kenya Institute of Education
24th March, 1971

SSP Biology School Visits

On behalf of Mr. Joseph Kimura, Dr. Rex Meyer and myself I am writing to express our gratitude for your cordiality and co-operation during our recent visit to your school. We were extremely pleased with what we saw and learned about the progress of SSP Biology in your school and would like to assure you that you have helped us immeasureably in our work of revising and evaluating the effectiveness of the course.

We were particularly grateful for the way in which you were able, on such short notice, to assemble students in Forms I, II and III in order for us to administer our short unit test based on Year I material. We are gratified to report that all forms showed excellent retention and understanding of material taught in Form I; upper forms, particularly Form III, showed a definite trend toward deeper understanding of more difficult concepts.

You may remember that we also asked pupils to write short comments on what they liked and disliked about SSP Biology. We found a high degree of acceptance and enthusiasm for SSP Biology on the part of pupils. Form III students showed a significant gain in their appreciation of the objectives of the course as compared with Forms I and II. Criticisms of SSP centred around frustrations due to lack of equipment, lack of success in performing experiments and desire for more written material for study rather than basic objections to the philosophy or content of the course.

Yours sincerely,

Dr. Sylvia Frank
for Secretary,
Kenya Institute of Education

II PRELIMINARY EVALUATION OF SSSPP BIOLOGY IN THE SSSPP SCHOOLS IN ZAMBIA

A Report by: J.W. Barks — Director, Curriculum Development Centre Lusaka

J.V. Huxley — Inspector of Schools, Ministry of Education, Zambia

R. Meyer — Unesco Consultant, Director, Centre for Advancement of Teaching, Macquarie University, Sydney, Australia

I. Introduction

In mid-1967 the Ministry of Education, in conjunction with the Science Education Centre, decided to start trials of adapted Nuffield materials in a small number (5) of selected Zambian Secondary Schools and in its Secondary Teacher Training College. At the time of introducing the first adapted materials into the schools (January 1968) it was the intention that all five schools carry out the trials in the three main subjects (Biology, Chemistry and Physics), that each school retain 'control' forms in which the regular Ministry of Education General Science would be followed and that the project material should eventually cover all forms from I to V.

The five project schools have all been engaged in trials of the material for the three subjects since the inception of the project. Administrative difficulties have forced four of the schools to drop the idea of 'control' forms and a recent change in the pattern of the Zambian Secondary School system (from a 2:3 pattern to a 3:2 one) has meant that the project has now been temporarily stopped at Form III.

At the time of writing (April 1971), the following summarises the progress of the project thus far:

Year of entry into Form I

i) 1968
ii) 1969
iii) 1970
iv) 1971

i) The 1968 Form I entrants wrote a special SSSPP examination at the end of Form II (November 1969) and a portion have gone on to regular COSC work;

ii) the 1969 Form I entrants wrote a special SSSPP examination at the end of Form II (November 1970). Most of these have gone on to Form III and will write a further SSSPP examination at the end of 1971;

iii) the 1970 Form I entrants will write a special SSSPP examination at the end of Form III (November 1972). About half will leave school and half will go on to regular COSC work in Forms IV and V;

iv) the 1971 Form I entrants will write their SSSPP examination at the end of 1973. About half will leave school then and the remainder will go on to the Senior School.

At a meeting of the SSSPP group at the end of 1970, it was decided that the project should move away from its previous emphasis on the separate subjects to one based on a more integrated approach. This new material is being tried out with the 1971 Form I entrants.

** Note on the Structure of Zambian Secondary Schools

Pupils entering Form I in 1969 and previous years passed through a 2.3 pattern. At the end of Form II, all pupils wrote a Junior Secondary School Leaving Examination. About two thirds of these then went on to Form III and studied courses leading to the COSC at the end of Form V.

Pupils entering Form I in 1970 and following years will follow a 3.2 pattern. The J S S L E. will be taken at the end of Form III with the last two years being devoted to COSC work. The percentage of Form III pupils passing on to Form IV will be 50%.

The J S S L E. examination is set and marked in Zambia.

II Evaluation of the Project

Whilst a certain amount of evaluation has been carried on throughout the time of the project, this has never been sufficient or systematic. The main reason for this has been the lack of any full-time staff for the project.

During the latter half of March 1971, a small group of workers from the Curriculum Development Centre, Lusaka, visited the five project schools and with the assistance and guidance of Dr. R. Meyer of Unesco, carried out a preliminary evaluation of the SSSPP Biology material. The main aims of this preliminary evaluation were:

i) To assess the retention and development of certain key concepts studied in Form I;

ii) to assess the effectiveness and acceptability of the discovery approach from the point of view of pupils and teachers;

iii) to study the level of difficulty liable to occur when pupils transfer from SSSPP to regular COSC courses;

iv) to look into the problems and difficulties of administering the SSSPP course,

v) to assess the relevance of the SSSPP mateiral from the point of view of teachers and pupils;

vi) to make recommendations regarding the future of SSSPP.

III Procedure

67 At each of the five project schools a representative class was selected from each of Forms I, II and III. In one school, classes from

Forms I and II only were available as it had not yet reached Form III.

Each pupil in these classes was asked to complete a short multiple choice test based on a unit of SSSPP Biology which is studied in Term I of Form I. This Test and Answer Sheet are given on pages 92-96.

Each pupil was also asked to write a few sentences about his likes and dislikes in the course.

The headmaster and teachers involved in teaching the SSSPP Biology material were interviewed, the interview being based on a standard set of questions. See page 97.

The facilities of the school for the teaching of biology were observed. These observations took into account equipment, class and laboratory space, and school grounds.

Finally, the group of evaluators met to assess the results of the tests, pupil comments, interviews and observations in order to assign various ratings related to different aspects of the course. These ratings are discussed later in this report.

IV. The Multiple Choice Test

The various questions in this test attempted to assess achievement in the:

1. Knowledge of the use of the word 'key' in a biological sense;
2. knowledge of a situation involving the process of classification;
3. evaluation of the suitability of given scientific terms for a described plant;
4. use of knowledge about plant growth under described experimental conditions;
5. evaluation of the least variable characteristic amongst a number of given characteristics;
6. application of knowledge of plant and animal groups to the interpretation of a situation involving the classification of a group of organisms;
7. evaluation of possible reasons for classifying organisms;
8. comprehension involving the use of a pie chart in a specific case;
9. evaluation of the suitability of given words to describe the features of certain leaves;
10. application involving the use of a biological key.

V. Results

Table I summarises the results of this multiple choice test in the five SSSPP schools.

Table I

Frequency Distribution Total of all Schools

Score		Form I	Form II	Form III
10		0	2	4
9		2	2	8
8		6	3	16
7		5	11	20
6		18	22	26
5		32	42	25
4		39	34	23
3		36	32	4
2		25	11	1
1		13	3	0
0		0	0	0
N	=	176	162	127
Mean	=	3.90	4.56	6.05

Table II summarises the preformances of each of the forms on each of the questions.

Table II

Performance of all Forms on Individual Questions

Question	Form	Choices A	B	C	D	% Correct
1	I	31	26	46	72	26
	II	30	37	38	46	24
	III	16	24	66	19	52
2	I	9	38	4	127	72
	II	8	4	0	148	91
	III	4	3	0	119	94
3	I	4	32	37	103	24
	II	4	39	29	85	24
	III	2	60	18	46	47
4	I	36	34	77	25	44
	II	22	35	83	16	52
	III	11	37	75	3	59
5	I	16	55	72	36	41
	II	20	33	76	30	47
	III	12	18	77	19	61

The correct choice is underlined.

Table II (cont/d)

Performance of all Forms on Individual Questions

Question	Form	Choices A	B	C	D	% Correct
6	I	84	62	22	9	48
	II	90	52	15	4	56
	III	88	27	8	2	69
7	I	0	35	54	87	50
	II	2	16	54	98	61
	III	1	13	20	92	73
8	I	40	85	3	50	23
	II	31	78	4	42	19
	III	53	42	0	30	42
9	I	43	24	38	70	40
	II	22	27	24	80	49
	III	10	13	23	80	63
10	I	24	50	51	33	29
	II	19	56	50	17	33
	III	17	29	66	9	52

The correct choice is underlined.

Comments on Individual Questions

Question 1

Not very well done except in Form III. Alternative D was too great a distractor for most pupils.

Question 2

Well done by all pupils. Knowledge retained in Forms II and III.

Question 3

Poorly done but with increasing comprehension through the forms. Superficial characteristics too readily selected.

Question 4

A gradual improvement through the forms but pupils had difficulty in applying knowledge to the experimental situation.

Question 5

Choices B and D distracted many pupils.

Question 6

Again, a gradual improvement through the forms with choice B being the strongest detractor.

Question 7

Quite well done with choice A offering almost no attraction to pupils.

Question 8

Very poorly done. Pupils obviously did not apply the pie chart to the circumstances given in the question. As shown by choice B, pupils applied their knowledge to the more general case.

Question 9

With the poor results in Forms I and II, this question would seem to indicate that pupils do not understand the concept of variability.

Question 10

Poorly done except in Form III. Pupils are not really able to use a biological key.

Results in Individual Schools

These are summarised in Table III.

Table III

Results of SSSPP Schools

School (in rank order)	Form I	Form II	Form III	Pupils	Lab Facilities
	Means				
1	4.6	4.6	5.5	Mixed	Good
2	4.8	4.3	6.4	Boys	Good
3	3.6	4.8	-	Mixed	Excellent
4	3.5	4.6	7.0	Boys	Excellent
5	3.2	4.9	5.4	Boys	Good

The staff in these schools, as in most Zambian Secondary Schools, is almost entirely expatriate at the moment. School 3 had a Zambian Headmaster and a Zambian Science teacher in the project.

General Comments on the Results

The results show that the project material studied early in Form I is being retained as the pupils move up through the school. The project is more than meeting this aim.

A study of the means and of individual questions shows that although there is no great difference between the forms, pupils appear to be able to increasingly use and apply the concepts first introduced in Form I.

It is difficult to make a statement about the transferability of the SSSPP to other Zambian schools. The five schools originally selected for the project were not typical of most other Zambian schools and, indeed, an effort was made to use the SSSPP materials in some of the 'better' schools. More about this is said later on.

VI. Pupil Comments

An analysis of the comments made by pupils shows that the great majority of them accept the philosophy of the SSSPP material. They enjoy doing practical work and using apparatus on their own, they accept (some reluctantly) the idea of not being given 'notes' and feel that the course is useful. Some pupils feel the need for some form of text quite strongly and find the nomenclature and terminology difficult. The large majority of pupils remain content orientated and commented primarily on specific content items of the course. This could be attributed to the public examination which all must sit at the end of Form III and which requires that some 50% leave school then.

In general, pupils are entering into the SSSPP course readily and accept its spirit and aims.

VII. Resources of the SSSPP Schools

Table IV summarises the resources available in the SSSPP schools.

This table is based on interviews with Heads and SSSPP teachers. It is also based on a survey of the facilities at each school by the evaluation workers.

The ratings are a consensus of opinion of the workers and it is encouraging to note that few large differences of opinion arose during the discussions to arrive at the ratings.

Table IV

Resources in the SSSPP School

School (in rank order of achievement)	1	2	3	4	5
A Technical					
1 Adequacy of school grounds	Ex.	Ex.	Poor	Ex.	Good
2 Glassware, chemicals, etc.	Ex.	Ex.	Ex.	Ex.	Ex.
3 Specialised apparatus, e.g. microscopes	Good	Good	Good	Good	Good
4 Laboratory space	Good	Good	Ex.	Ex.	Good
5 Equipment, innovations	Poor	Poor	Good	Good	Poor
6 Extracurricular enrichment	Good	Poor	Poor	Ex.	Good
7 Laboratory technicians	Poor	Good	Good	Good	Good
8 Library and other materials	Poor	Good	Poor	Good	Good

Table IV (cont/d.)

Resources in the SSSPP School

School (in rank order of achievement)	1	2	3	4	5
B Staff					
1 Permanence of tenure	Good	Good	Poor	Ex.	Good
2 Academic qualifications	Ex.	Ex.	Ex.	Ex.	Ex.
3 Attitude towards SSSPP philosophy	Good	Poor	Good	Ex.	Ex.
4 Feeling of adequacy	Poor	Good	Good	Good	Good
5 Success in emplementing SSSPP philosophy	Good	Good	Good	Good	Good

The following generalisations may be drawn from this table:

i) Facilities do not seem to have a great effect on the course. All five schools have the same equipment and have similar laboratories and school grounds. Yet, the results are not strictly comparable. However, the question of whether less well equipped schools could adequately handle the project remains open.

ii) Teachers were more pessimistic about the course than the results of their pupils warrants.

iii) There seems to be no definite correlation between staff feelings and results. The staff in schools 4 and 5 expressed full sympathy with the spirit of SSSPP yet their schools did less well than others where the attitude was not quite so positive.

This could be taken to mean that the project material can be adequately handled by teachers of widely differing attitudes and temperaments.

VIII Summary Evaluation

Table V gives ratings (on a scale of 0 - 100%) for a number of criteria of acceptability of the SSSPP material. It compares pupils and teachers. This table was compiled by the team after all schools had been visited.

Table V

Summary Evaluation

Item	Teacher Rating (As teachers judge their own effectiveness)	Pupil Rating (Effectiveness as judged or achieved by pupils)
1 Understanding basic concepts	45%	55%
2 The discovery method		
a) Acceptance by teacher and pupil	65%	80%
b) Effectiveness	50%	60%
3 Relevance of content to pupils after leaving school	30%	40%
4 Difficulty of the material	60%	60%
5 Some problems		
i) Availability of equipment	90%	90%
ii) Adaptability of teachers and pupils to the new philosophy	65%	80%
iii) Degree of improvisation	20%	20%
iv) Suitability of teachers	75%	-
v) Judgment of suitability for average or below average schools	20%	-
vi) Continuity from Form III to IV	50%	-
vii) Usefulness of aspects of SSSPP in any other new project	50%	-

IX. Summary and Suggestions for the Future

In general, the SSSPP material is meeting its initial aims in the selected schools. It is well accepted by staff and pupils and is not causing any serious administrative difficulties in the project schools. Causes for concern are its relevance to the conditions of Zambia and the content orientation which is still retained by many pupils. The effects of the change to a 3:2 structure need careful study with reference to the progression from Form III to IV.

From this evaluation, it seems fairly certain that most of the SSSPP material could not be transferred to a large number of other schools in its present form. The five schools in the project are somewhat atypical in their selection of pupils, their ability to retain staff and their location along the line of rail. They are not particularly different from the bulk of other Zambian Secondary Schools in their facilities and resources. Although all were given a special grant of equipment at the start of the project, other schools have also been generously supplied during the period of the project.

It is suggested that an attempt now be made to extract useful and relevant portions of the SSSPP and to try these out in other schools which represent a typical sample of the secondary schools in the country. This could be nine schools. It is also suggested that the present SSSPP schools continue with their work on an integrated course for the junior school with the idea that useful material be fed into any other trials which might be started. The purpose of these trials would be to produce materials for a 'General' or 'Integrated' Science course for Forms I, II and III in, eventually, all Zambian Secondary Schools.

Biology Test and Answer Sheet
(see pages 92-96)

Interview with Biology Teacher
Standard Questions
(see page 97)

III PRELIMINARY EVALUATION OF THE EFFECTIVENESS OF UNESCO BIOLOGY FOR THE JUNIOR CERTIFICATE COURSE IN FOUR OR FIVE TRIAL SECONDARY SCHOOLS IN MALAWI (APRIL 1971)

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I Introduction

From September 1967 to July 1968 a representative from Malawi, Mr E. Mwasi, attended a writing workshop at Cape Coast, Ghana to produce experimental editions of teaching units as part of the Unesco Pilot Project for Biology Teaching in Africa.

At the same time a study group of university biologists and biology teachers was set up in Blantyre by the Ministry of Education under the leadership firstly of Professor Margaret Kalk and then Dr. P. Mwanza of the University of Malawi. The booklets prepared in the Cape Coast were carefully appraised by the study group and Units 1 to 6 and 8, 9 and 10 were considered as a suitable basis for a course for Forms I and II leading to the Junior Certificate Examination. These units, with minor amendments and omissions were then made the basis of a programme which was tried in five secondary schools, these schools were from good to average in pupil intake, technical resources and teacher qualification and background.

The course now (April 1971) is in the Second Form and the first Junior Certificate Examination for the Unesco programme will be in August 1971.

The study group has supervised the trials, conducted in-service courses for trial teachers and issued some supplementary notes (e.g. a detailed statement of objectives for each unit). Tests have been prepared and issued to schools. The group has also been responsible for pre-testing items for the first Unesco Biology Junior Certificate Examination to be given later this year.

The experimental phase of the programme is therefore drawing to a close. On evidence from the trials the Unesco booklets will be re-written and moulded into a course of direct relevance to Malawi. The Ministry of Education will then make the decision, perhaps in 1973, whether or not the new course should be introduced to all secondary schools.

In April 1971, in order to assist the study group with the re-development of the units and to give the Ministry of Education some preliminary information on the effectiveness of the course at this stage of its development, a small team of curriculum workers visited four of the five trial schools for evaluation of the programme. They aimed to assess

the effectiveness of the programme in

i) development of understanding of key biological concepts;
ii) acceptability and effectiveness of the discovery approach adopted in the new course;
iii) the relevance of content;
iv) the level of difficulty of the programme;
v) attitude of pupils and teachers towards the new course;
vi) problems associated with teaching specific units and any other administrative or other difficulties associated with the programme;
vii) the suitability of the course for all secondary schools of Malawi.

The four schools were representative of good to average secondary schools in Malawi. The fifth school could not be visited because of staff changes and other administrative difficulties.

II. Methods

At each school the following procedures were used:

1. A representative class from Form I and Form II was given a short multiple-choice achievement test on Unesco Unit I "The Living World Around Us". This test is given in this report on pages 92-94.

2. Each pupil was asked to write a short statement on what he liked or did not like about this biology course.

3. A specially prepared demonstration lesson was given by the Unesco biology teacher. This lesson was critically observed and rated on achievement of the objectives of the course.

4. One of the curriculum workers gave one micro-lesson to a Unesco class to assess ability to solve an unseen problem by questioning the teacher. Pupils response to the micro-lesson were rated on various criteria.

5. The school principal and biology teacher were interviewed about the acceptability of the new programme and especially about specific problems and difficulties involved in the teaching. The interview was standardised (see page 97).

6. The facilities for teaching biology in classrooms, laboratories and school grounds were observed.

7. Shortly after leaving the school the curriculum workers assessed evidence from tests, essays, lessons, interviews and observations, and used this to obtain ratings for various criteria of acceptability of the new course.

In addition, one member of the evaluation team visited two schools following the traditional programme of biology and for the purpose of control administered the achievement test and the interest essays to representative classes in Forms I and II. Care was taken to select schools equivalent to the trial school in pupil intake and technical resource. A check was also made to ensure that the concepts tested in the achievement test had also been covered in the control classes. The results of the study are given below.

III. Results

A. Achievement Test

A standardised test of ten only multiple choice questions was administered to Forms I and II in each of four trial schools and two control schools (see page 92). The test assessed the following mental skills and biological concepts:

1. Knowledge that a key is useful for the identification of organisms.
2. Analysis of a situation involving the process of classifying.
3. Evaluation of the suitability of given words for naming a described plant.
4. Application of knowledge of plant characteristics to interpret growth under experimental conditions.
5. Evaluation of the most appropriate characteristic to give the least variable measurements.
6. Application of knowledge of plant and animal groups to the interpretation of a situation involving the classification of a group of organisms.
7. Evaluation of possible reasons for classifying organisms.
8. Comprehension of a pie chart in a specific case involving animal groups.
9. Evaluation of the suitability of given words to describe the features of described leaves.
10. Application involving the use of a biological key.

The frequencies of scores and the mean scores obtained by Forms I and II in the four trial schools and the two control schools are given in Table I.

Table I

Frequency Distributions of Scores on Achievement Test in Four Trial Schools and Two Control Schools

Score	Trial Schools			Control Schools		
	Form I	Form II	Both Forms	Form I	Form II	Both Forms
10	0	2	2	0	0	0
9	2	5	7	0	0	0
8	9	15	24	1	3	4
7	21	15	36	5	9	14
6	33	37	70	13	11	24
5	27	36	63	15	14	29
4	27	16	43	15	9	24
3	7	5	12	14	5	19
2	2	1	3	4	1	5
1	0	0	0	2	0	2
0	0	0	0	0	0	0
N	128	132	260	69	52	121
Mean	5.4	5.9	5.7	4.5	5.3	4.8
Standard Deviation	1.46	1.53	1.51	1.51	1.43	1.55

These results are summarised in Table II.

Mean Scores on Achievement Test in Four Trial and Two Control Schools

Forms	Schools Compared	N (Pupils)	Mean Score	Standard Deviation
I	Unesco trial	128	5.4	1.46
	Traditional	69	4.5	1.51
II	Unesco trial	132	5.9	1.53
	Traditional	52	5.3	1.43
I and II	Unesco trial	260	5.7	1.58
	Traditional	121	4.8	1.55

Table III summarises the performance of each of the Forms in the trial schools only on each of the ten questions.

Table III

Summary of Performance on Individual Questions in the Trial Schools Forms I and II

(N Form I = 128 N Form II = 132)

Question	Form	A	B	C	D	Correct Answer	% Correct
1	I	2	4	109	13		85
	II	2	3	115	12	C	87
2	I	18	3	0	106		83
	II	19	3	0	109	D	83
3	I	3	40	22	59		31
	II	4	51	27	49	B	39
4	I	22	24	61	20		48
	II	17	21	69	20	C	53
5	I	4	18	75	31		58
	II	8	15	88	15	C	67
6	I	100	17	8	4		78
	II	95	25	7	4	A	72
7	I	0	19	20	90		70
	II	0	16	16	99	D	75
8	I	32	32	3	60		24
	II	22	52	2	57	A	17

Table III (cont/d)

Summary of Performance on Individual Questions
in the Trial Schools
Forms I and II

(N Form I = 128 N Form II = 132)

Question	Form	A	B	C	D	Correct Answer	% Correct
9	I	44	30	14	37		29
	II	31	34	16	45	D	34
10	I	28	26	60	11		47
	II	27	17	74	5	C	56

Comments on Individual Questions

Question	Comment
1	Most pupils knew the purpose of a key in biology and there was a slight improvement in knowledge from Form I to Form II.
2	Both Forms I and II had no trouble in analysing the single situation involving the process of classifying.
3	A definite improvement from Forms I to II in evaluating the suitability of a name for a described organism. On the whole though, candidates could not answer this question choosing inappropriate or irrelevant combinations of names.
4	Again while there was an improvement from form to form only about half the pupils could apply their knowledge of the characteristics of fungi to the interpretation of the simple situation presented in the question.
5	Pupils in Form I were often distracted by D not appreciating the extremely variable nature of behaviour. There is an improved awareness in Form II that the most suitable characteristics for classification systems were those that would be the least variable.
6	Generally well answered in both Forms I and II. Most pupils could apply this knowledge of major groups to the interpretation of the situation.
7	Most pupils were able to evaluate the role of classification systems in biology and there was a slight improvement from Form I to II.
8	This proved very difficult for both forms. Pupils could not comprehend the pie chart, usually not understanding that it referred only to the sample defined and not to the general occurrence of living organisms.

Question	Comment
9	While there was some improvement from Form I to Form II this showed that most pupils either did not know the meaning of the word "variable" or else could not evaluate a situation requiring its understanding.
10	Only about half the pupils could use a biological key to identify an unknown organism. There was some improvement from Form I to Form II.

Results in Individual Schools

These are summarised in Table IV.

Table IV

Mean Achievement Scores in Four Trial Schools (1 to 4) and Two Control Schools (5 and 6)

School (In rank order of achievement)	Unesco Experiment or Control Traditional	Form		Boarding or Day School	Biology Teacher		Head-master	Boys or Girls	Quality of Laboratory Facilities
		I	II		Nationality	Grad.			
1	Unesco	5.5	6.3	Boarding	Malawi	No	Dutch	Boys	Excellent
2	Unesco	5.9	5.6	Boarding	Malawi	No	British	Mixed	Good
3	Unesco	5.2	6.1	Day: self-help Boarding	Malawi	No	Malawi	Mixed	Poor
4	Unesco	5.5	5.5	Day	Malawi	Yes	Malawi	Mixed	Good
5	Control	4.8	5.2	Day	Malawi	No	Malawi	Mixed	Good
6	Control	4.0	5.4	Day	Malawi	No	British	Mixed	Good

General Comments on the Results of the Achievement Test

1. While there was no statistically significant difference between mean scores of trial and control schools (Tables I and II) there was a slight trend in favour of trial schools (see especially Table IV).

2. The test showed a good retention and understanding of material taught in Form I into Form II.

3. While there was no overall statistical significance between performance of Forms I and II, analysis of individual questions (Table III) showed a definite trend towards deeper understanding of more difficult concepts in Form II. (Questions 2, 3, 4, 5, 7, 9 and 10).

4 Comparing different schools, it appeared that whether the Headmaster was Malawian or not, whether the students were boys and girls or whether the laboratory facilities were poor or good, did not seem to significantly influence the achievement of pupils, which averaged about 55 to 60% in trial schools (note 40 to 55% in control schools) There was some suggestion however that pupils in boarding schools were more successful than those in day schools It may also be significant that the only school with a rating for excellent for laboratory facilities was first in rank order of achievement

Pupils Likes and Dislikes

The comments made by pupils on what they liked and did not like were analysed first by reading them through to identify categories The individual statements were then placed into these categories, scored by frequency of mention and scores were expressed as percentages of the numbers of pupils in the study Separate analysis were made for trial schools and control schools The results are given in Table V.

Table V

Percentage Frequency of Comments Made by Biology Students in Unesco and Traditional Programmes

Aspects Liked	Form I		Form II		Form III	
	Unesco Experiment	Traditional	Unesco Experiment	Traditional	Unesco Fxperiment	Traditional
	N= 128	N= 69	N= 132	N= 52	N= 260	N= 121
1 Interest in plants and animals	73	83	39	58	55	72
2 Practical work	35	8	43	8	39	8
3 Ease of remembering and understanding	11	6	52	19	32	11
4 Relevance to life	12	20	26	12	19	16
5 Discovery approach Independence of work and thought	15	1	24	0	19	1
6 Pupils books interesting and easy to read	6	0	19	0	12	0
7 Human body and Man's place in nature	9	30	16	10	10	22
8 Field work and outdoor collecting	4	13	5	2	4	8

Aspects not Liked	Form I		Form II		Forms I & II	
	Unesco Experiment	Traditional	Unesco Experiment	Traditional	Unesco Experiment	Traditional
	N= 128	N= 69	N= 132	N= 52	N= 260	N= 121
1 Some concepts difficult (especially terminology)	17	22	21	10	19	17
2 Some structures or organisms unpleasant or dangerous	11	16	11	0	11	9
3 Not enough equipment	1	0	7	0	5	0
4 Lack of success in performing experiments	1	1	9	2	5	2
5 Need for supplementary work, e.g. too many notes needed	7	0	3	4	5	2
6 Practical work	3	10	7	6	5	8
7 Field work and outdoor collecting	2	12	9	0	5	7
8 Pupil books difficult or lacking	3	0	5	4	4	2
9 Having to think for oneself	3	0	5	0	4	0
10 Not enough time for work	1	4	5	0	3	3
11 Some concepts uninteresting (e.g. plants or insects)	5	13	1	12	3	12

The following are some quotations from pupils giving sample statements and how they were classified. All examples are from trial schools only.

B. Aspects Liked

1. Interest in Plants and Animals

It helps me know some things like living and non-living things and to know their structure. It helps me know how certain animals develop.

It is important to study living things so that we know their characteristics and how they are made.

About plants as food producers and animals as food consumers and patterns of reproduction and development.

I like the topic concerning reproduction and fertilisation.

2. Practical Work

I like doing experiments.

I like my course because we do a lot of practical work, in so doing we know much by ourselves so when we go back to our books I find everything easy since we have already done everything by setting experiments.

Because I have a chance to use the microscope and some chemicals.

We learn by seeing with our eyes by doing experiments, this comforts me and makes me not to forget many what we covered very long ago.

3. Ease in Remembering and Understanding

Our teacher teaches us very well and everything he teaches is almost understood.

This course is easier than the former course even though I am not good at it.

I like it because I understand the teaching quickly.

This course is easy to understand. It is not easily forgotten. Studying is easy. Notes taking is easy and you can easily find out how things are made.

4. Relevance to Life

It serves us as a study in schools to have better lives.

Because in future I like to be a doctor and its my advantage to know the micro-organisms and all living things in nature.

What is good in biology course is that after finishing you can become a nurse and help people through biology.

It tells us how to have a good life by studying more about diseases, types of food and reproduction.

5. Discovery Approach : Independence of Work and Thought

I like it because I learn to use my head (thinking) and to find out about things which I do not understand by investigating the thing or even performing an experiment.

I like the biology course because we do the experiments as scientists

It enables us to see clearly what a thing means. This is by doing investigations.

It has some experiments and some questions which we answer on our own. This encourages every student to work hard on his assignments and not be lazy.

6. Unesco Books Interesting and Easy to Use

The questions that are put at the end of every book enables me to have a good revision.

The units we have so far covered are well planned and therefore all were understood.

Drawings good, they are not mixed up like in other books. Simple English, there are not very many difficult words.

The notes given in the books are short and easy to study. The experiments which are given are very simple and enjoyable.

7. The Human Body and Man's Place in Nature

I like biology because it tells us the structure of any human being. The most thing I like best is the study of blood circulation.

I like studying about animals in biology course because it helps me to know who I am and in what group I belong, and what role I play.

By studying what we are made of and how our bodies work normally.

I know many things about my body and what kind a food is required.

8. Field Work and Out-of-Doors Collecting

I like to go around the bush observing living things how they live and how they produce.

In biology course I like both the lessons in the class and the work we do outside. For example collecting insects outside, grouping them, classifying and identifying.

We go out and observe things we are taught and find out the truth.

I enjoy going out investigating unknown animals and plants and giving them scientific names. Very funny names.

C Aspects Not Liked

1. Some Concepts Difficult (Especially Terminology)

I find a difficult work to make a key.

Because some of the words are difficult to pronounce and difficult to understand what they mean.

I do not like about my biology because there are big words to the words puzzle me to know what they mean.

We learn things that are complicated that I can't understand.

2. Some Structures or Organisms Unpleasant or Dangerous

I don't like to catch snails and the bones of dead animals.

I do not like biology because there are many kinds of smell and I do not fell well.

Because we do see dangerous animals such as snakes.

Because you catch bad things and rotten things.

3. Not Enough Equipment

The only thing is that we have not many equipments to fit this course in our laboratory.

We don't complete some of the experiments due to lacking of certain apparatus.

Our microscopes are not very good.

We are not given specimens of our own.

4. Lack of Success in Performing Experiments

We do our own experiments and get the results ourselves. Sometimes the results are wrong and we go astray.

If we don't know we just leave the experiment.

I do not like this because sometimes the experiments don't do well and by these errers we don't know what to do.

I don't like it because there are a lot of experiments and sometimes I fail to do them.

5. Need for Supplementary Work, e.g. Too Much Note Taking or Not Enough Notes Provided

Sometimes we do not like the biology course becuase they write short explanation.

Because there is no much notes in biology and too difficult to understand things.

Because we always have much notes.

I don't like biology because we don't have many notes which we can study more than in the book.

6. Practical Work

I do not like about my biology course because we usually have an experiment after having read of some information.

I don't like Biology course because of the drawing.

Because if we are doing experiments I do not hear any thing.

In my biology course I don't like it because it has a lot of experiments an it needs careful observation.

7. Field Work and Out-of-Doors Collecting

I don't like collecting animals.

I don't like some things because we go in the bush to examine some things which is not good.

This is the thing I hate most because we walked in the sun.

8. Pupils Books Difficult or Lacking

I don't enjoy the subject because sometimes English seem to be hard to use.

I don't like biology mainly because it seems difficult to me and moreover I don't understand what the book teaches me about.

I do not like my biology course because we have fewer books at our school. So its very difficult to take it at the Hostel for further practice while others are busy with it.

We do not have proper text books.

9. Having to Think for Oneself

I do not like my biology because biology is tough and uses brain.

I don't like biology for that it needs much thinking and I am not good in thinking.

I don't like to answer so many questions.

I do not like our biology course because sometimes it needs guess work.

10 Not Enough Time for Work

I do not like it because we have only half an hour for biology and twice a week.

What I do not like about your biology course is that some of the experiments takes a long period to be performed, in so doing we delay very much.

The experiments are too many so they waste most of the time instead of spending the time in learning we spend them in doing the experiments.

I don't like too many investigations in the units but often there is no enough time to finish them.

11 Some Concepts Uninteresting

I don't like about the studying of plants.

The only thing I don't like is making key and classifying the animals and the leaves.

I do not like biology about the names written in Latin language.

I don't like learning about non-living things.

General Comments on Likes and Dislikes of Pupils

Results in Table V show the following trends.

1 More Form I pupils mentioned their interest in plants and animals than Form II and this type of interest was generally higher in the control schools than the trial schools.

2 In almost all other categories liked there was a significant improvement from Form I to Form II in the trial schools. In the control schools there was either no change or a decline in interest from Form I to II in 7 of the 8 categories.

3 Almost 20% of the pupils in the trial schools expressed interest in the "discovery" method but this was mentioned by only one pupil out of 121 in the control schools.

4 Pupils in control schools showed less interest in practical work than those in trial schools.

5 Interest in factual material such as the structure and identification of plants and animals or the structure and functions of the human body was greater in the control schools than the trial schools.

6 In Form II more than half of the pupils in the trial schools compared with 19% in the control schools mentioned the ease of remembering and understanding the material.

7 The number of pupils commenting unfavourably on either trial or control courses was much less than those commenting unfavourably.

8 Criticisms of the courses were mainly in terms of the difficulty of selected concepts and in the terminology required and there was little difference in this regard between control and trial schools.

9 About 10% of pupils in both courses commented unfavourably on unpleasant aspects such as dangerous organisms, noxious smells, sickening dissections or the need to kill harmless animals.

10 In general there was strong acceptance of the basic objectives of the programme and a fair appreciation of its relevance to Malawi and to life after school.

D. Observation of Lessons

One member of the curriculum team gave a fifteen minute lesson to a selected class in each of the four trial schools. Pupils were required to solve an unseen problem by observation and by questioning the teacher. Their responses were rated on a percentage scale by the person giving the lesson and by one observer. The results are given in Table VI.

Table VI

Achievement by Unesco Trial Classes in Solving an Unseen Problem Presented as a Micro-Lesson. Consensus of Independent Percentage Ratings by Two Observers. (Percentage Ratings)

Response	School (In Rank Order on Achievement Test - see Table IV) 1	2	3	4	Average Rating
1 Willingness to answer questions	90	80	20	80	68
2 Level of interest	90	60	50	80	70
3 Success in solving the problem	60	70	30	70	58

Each Unesco teacher was asked some days before the visit to prepare a demonstration lesson. This lesson was presented at the time of the visit and observed by the curriculum workers. Ratings of the extent to which the lesson contributed to the objectives of Unesco Biology were made on a ten point scale. The results are shown in Table VII.

Table VII

Achievement of Objectives of Unesco Biology in Demonstration Lessons by Unesco Trial Teachers (Concensus of Ratings (1 - 10)) by Two Observers

Objective	Schools (In Rank Order on Achievement Test) 1	2	3	4	Average Four Schools
A Knowledge and Understanding					
1 Knowledge of facts in text	5	6	5	4	5
2 Understanding of facts in text	5	6	4	4	5
3 Response to questions	7	6	5	5	6
4 Understanding of principle of experiments	-	5	5	2	4
5 Understanding conclusions from experiments	-	5	4	2	4
6 Ability to reach independent conclusions	6	5	4	2	3
Average Knowledge and Understanding	6	6	5	3	5
B Emotional Reactions					
7 Interest during introduction to lesson	6	2	7	8	6
8 Interest during main part of lesson	6	3	7	6	6
9 Interest during conclusion of lesson	4	3	5	2	4
10 Interest in demonstration experiments	5	4	4	5	5
11 Interest in experiments performed by pupils	6	3	6	7	6
12 General attitude to biology lessons	5	4	5	8	6
13 General scientific attitude	6	4	4	4	5
Average Emotional Reactions	5	3	5	6	5
C Practical Skills					
14 Making biological drawings	-	-	4	3	4
15 Handling glassware	-	6	6	-	6
16 Handling dissection instruments	-	6	-	-	6
17 Handling biological specimens	6	5	7	-	5
18 Handling measuring instruments	-	-	-	-	-
19 Using a lens	-	4	-	-	4
20 Using a microscope	-	4	6	4	5
Average Practical Skills	6	5	6	4	5

Table VII (cont/d.)

Achievement of Objectives of Unesco Biology in Demonstration Lessons by Unesco Trial Teachers (Concensus of Ratings (1 - 10)) by Two Observers

	Objective	Schools (In Rank Order on Achievement Test) 1	2	3	4	Average Four Schools
D	Recommended Teaching Methods					
21	Problem solving/verification	5	3	8	7	6
22	Pupil active/teacher active	3	2	4	3	3
23	Objects, materials/blackboard	5	4	8	7	6
24	Pupil experiments/ demonstrations	6	4	10	9	7
Average Teaching Methods		5	3	8	7	6

Summary: Average Ratings Four Schools -

Pupils Knowledge and Understanding = 5
Emotional Reactions = 5
Practical Skills = 5
Use of Recommended Teaching Methods = 6

Total Achievement of Objectives 50%

Comments on Observation of Lessons

1. Table VI suggests that on the whole pupils in trial schools are interested in and responsive to problem solving situations. By Form II their ability to reason through an unseen problem is very satisfactory.

2. In Table VII the results suggest that on the whole trial teachers are about 50% effective in achieving suitable teaching objectives in specific lessons. In lessons observed the four teachers make use of recommended teaching strategies to varying degrees - 30, 50, 70 and 80% of the time respectively.

E. Resources of the Unesco Trial Schools

Table VIII summarises the resources available in the four Unesco trial schools.

This table is based on interviews with headmasters and Unesco Biology teachers and on a survey of the facilities at each school made at the time of the visit. Ratings were on a three point scale - excellent, good or poor and are a consensus of the opinions of the curriculum workers. There were few differences in the ratings of individual observers.

Table VIII

Resources in Four Unesco Trial Schools
(Rated by Two Judges as Excellent, Good or Poor)

Resource	School (In Rank Order on Achievement Test) 1	2	3	4
A. Technical				
1 Adequacy of school grounds	Excellent	Excellent	Good	Good
2 Basic apparatus such as glassware	Good	Good	Poor	Excellent
3 Specialised apparatus, e.g. microscopes	Good	Poor	Good	Good
4 Laboratory space	Excellent	Excellent	Poor	Good
5 Laboratory fittings - water, electricity, gas	Good	Good	Poor	Good
6 Equipment Innovations	Poor	Poor	Poor	Poor
7 Extracurricular enrichment	Good	Good	Poor	Poor
B. Staff (Unesco Teacher)				
1 Academic qualifications	Good	Good	Poor	Excellent
2 Attitude towards Unesco Biology	Good	Poor	Good	Good
3 Feeling of adequacy in teaching the Unesco course	Poor	Good	Good	Good
4 Success in implementing philosophy of Unesco Biology	Poor	Poor	Poor	Poor

The following generalisations emerge from Table VIII.

1. Facilities do not seem to have had a strong influence on the course Satisfactory standards and adequate achievement of objectives occurred in schools with excellent facilities and with relatively poor facilities This is strong evidence in favour of the suitability of the course for the average secondary school in Malawi.

2. In spite of feelings of inadequacy in some teachers the course had been reasonably successful in attaining its objectives. There seemed to be little correlation between staff attitudes and the results. This might be taken as an argument that the course, perhaps through the structure of its materials, could be taught successfully by teachers of widely different attitudes and temperaments.

3. All teachers under-estimated their success in implementing the objectives of the course.

4. None of the teachers had used much initiative in improvising equipment or teaching ideas.

F. Summary Evaluation

Table IX gives ratings (on a scale 0% to 100%) for a number of criteria of acceptability of Unesco Biology in secondary schools in Malawi. It compares pupils and teachers.

The evaluators used the following scale in arriving at the ratings and drew somewhat impressionistically on all the data presented in this report.

Scale		
	0 - 20	Generally failed in effectiveness. Remedial action possible but difficult.
	21 - 40	Not successful but remedial action possible without too much difficulty.
	41 - 60	Acceptable level of effectiveness. Remedial action obvious and straight forward.
	61 - 80	Very satisfactory. Only minor problems which would be simple to overcome.
	81 - 100	Very high level of effectiveness. No remedial action necessary.

Table IX

Effectiveness of Unesco Biology Forms I and II in Malawi
(Summary % Ratings by Curriculum Evaluators)

Criterion	Ratings for Teacher (Effectiveness as seen by teacher or teachers effectiveness as observed)	Ratings for Pupils (Effectiveness as shown by pupil achievement)
1 Achievement of basic concepts by the pupils	45	60
2 The discovery of approach		
a) its acceptance	60	80
b) its effectiveness	60	75
3 Achievement of objectives in typical lessons	50	60
4 Relevance of content to life after school	40	30
5 Relevance of objectives to national aims	85	30
6 Extent to which problems of the course have been overcome:		
a) supply and maintenance of equipment	85	90
b) extent to which equipment has been improvised	10	-
c) suitability of teachers	45	-
7 Chance of success if transferred to other schools	90	-

IV. Discussion and Recommendations

The results of the evaluation study are most encouraging. An important finding is the satisfactory level in attainment of objectives of the course in spite of some unsatisfactory aspects of the teaching. Classroom techniques and feelings of inadequacy of the teachers are problems that can be easily overcome by in-service training and by improving the learning materials.

Part of the general feeling of inadequacy and relatively low success in some areas can possibly be traced to a weakness in structure of the Unesco booklets in their present form (the 1968 experimental edition). Teachers are unsure whether to treat them as conventional texts for reading; as workbooks or as combinations of these; and the approach in this regard varies from unit to unit. The teachers' guides in their present form do not help in this and are also deficient in other respects.

Already the study group has met (late April 1971) and produced samples of re-written pupils' texts and teachers' guides. The new editions will do much to overcome some of the technical problems.

A welcome finding has been the steady growth in understanding and acceptance of biological principles and of the philosophy of the course from form to form. Related to this are the high levels of interest and the feeling that it is straightforward and easy to learn. Teachers see that the course will be relevant to pupils in later life, but in re-writing the materials an attempt should be made to make this more directly obvious to the pupils. Apart from this disparity between pupil and teacher reactions it is interesting that the teachers have generally underestimated their pupil achievements and their attitudes to the discovery method.

The assessment by the evaluators that the course has a 90% chance of success in average and even below average schools in Malawi, is of vital significance. It would appear that the problems revealed in the evaluation study are relatively minor and can be easily overcome. It is strongly recommended therefore that the Ministry of Education give serious consideration to introducing this programme to all secondary schools, Form I and II, in, say, 1973.

Biology Test

1. A useful thing used by scientists to identify animals or plants is a

   A dictionary
   B bar chart
   C key
   D list of names

2. Two friends found a number of different animals. They sorted them into two groups - one group had all red ones, and the other group all black. They then sorted the red ones into those with wings and those without wings. The black ones they sorted into those with hair and those without hair.

   One word which would best describe what these friends were doing is

   A identifying
   B dividing
   C listing
   D classifying

3. A botanist discovered a plant with dull black hairy leaves, long thin stems and shallow roots. He wanted to give it a descriptive name. He could reasonably choose the Latin names of

   A short and shiny
   B tall and black
   C leaf and shallow
   D hairy and stem

4. Of the following, a plant which can grow well and gain weight in the dark is

   A fern
   B moss
   C fungus
   D alga

5. A group of boys and girls was studied by scientists. The children were different from one another in many ways. Of the following differences, the easiest to measure would be

   A strength
   B intelligence
   C height
   D behaviour

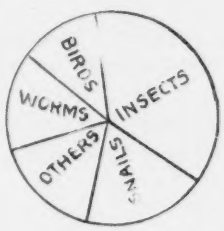
6. Given groups of insects, snakes, snails, birds, cats, worms and fish, a biologist who was asked to put them into groups would probably first group them into

   A vertebrates and non-vertebrates
   B with legs and without legs
   C living and non-living
   D small and large

7. One reason why scientists sort animals into groups is because

   A they enjoy making collections of animals
   B this tells them about the way of life of the animals
   C this helps them understand how animals grow and develop
   D this helps them understand how animals are related to one another

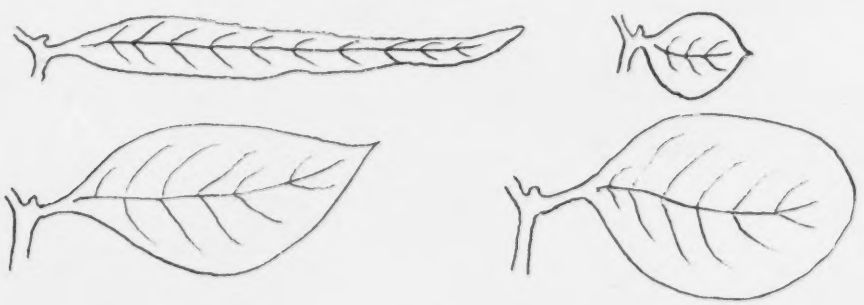
8. The diagram shows how a person reported the groups of animals he found in a certain place



   From this diagram we can conclude that

   A snails and insects together made up more than half of his collection
   B insects are the most numerous animals on earth
   C snails eat insects
   D the smallest group of animals in his collection was birds

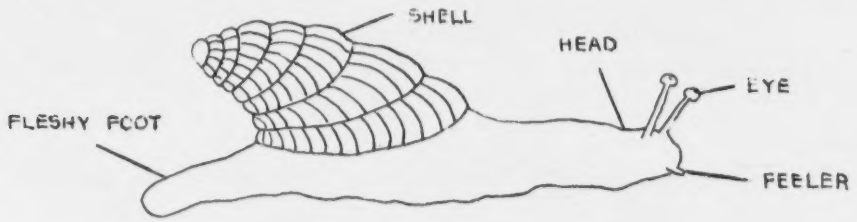
9. Compare the following leaves of the same species grown under different conditions. They are drawn to the same scale.



   An especially useful word to describe these particular leaves would be

   A green
   B flat
   C living
   D variable

10. Identify the animal in this drawing as I, II, III or IV, using the information given in the box below the drawing



1.	One long, fleshy foot present	5
	Fleshy foot absent	2
2.	Legs present	3
	Legs absent	ANIMAL I
3.	Three pairs of legs or less	4
	More than three pairs of legs	7
4.	Body longer than wide	ANIMAL II
	Body wider than long	7
5.	With shell	6
	Without shell	8
6.	Striped shell	ANIMAL III
	Spotted shell	7
7.	Stripes present on body	ANIMAL IV
	Stripes absent from body	8
8.	Not needed	

The animal is

A animal I
B animal II
C animal III
D animal IV

Answer Sheet

School .....

Name .....

Instructions to Candidates

All ten questions should be attempted.

Each question consists of information and an incomplete sentence. Four alternatives A, B, C or D follow each question and you should select the alternative that most fully and correctly completes that sentence at the beginning.

Your answer should then be marked with a dark cross in the space provided below. Use either pencil or ball point pen.

For example if question 11 was

The capital of Kenya is

A Kisumu
B Nairobi
C Mombasa
D Nakuru

you would place a cross in the box marked B as shown below.

11.	A	B	C	D

If you should change your mind, thoroughly black out or rub out your first mark. Answers with more than one alternative shown with a cross will score no marks.

REMEMBER TO ANSWER ALL TEN QUESTIONS. IF YOU ARE UNCERTAIN OF THE BEST ALTERNATIVE MAKE AN INTELLIGENT GUESS.

Your Answers

Question :					
	1.	A	B	C	D
	2.	A	B	C	D
	3.	A	B	C	D

Question :					
	4.	A	B	C	D
	5.	A	B	C	D
	6.	A	B	C	D
	7.	A	B	C	D
	8.	A	B	C	D
	9.	A	B	C	D
	10.	A	B	C	D

Interview With Biology Teacher
Standard Questions

1. Relevance

In what ways will this course be relevant to the pupils of your country when they leave school?

What are some of the shortcomings in this respect?

2. Difficulty

Do pupils find it difficult or easy with respect to traditional courses?

What percentage would you predict would pass in

	New Course	Traditional
Form 1		
2		
3		

Any especially difficult units?

3. Acceptability of the discovery method

Do pupils accept this method?
Do teachers accept this method?

4. Interest in the course

Level of interest as compared with traditional programmes

of pupils?) What is liked most?)
of teachers?) What is liked least?)

5. Preparation for Forms IV and V

Will the course give the necessary background for Forms IV and V Cambridge?

Explain.

6. Transferability

In your opinion how successful will the course be in the average and below average high school in your country?

7. Administration

What administrative problems have been met in the programme?

Cost per year
Equipment
Chemicals
Specimens
Field work
Staffing
Resource materials, etc.

8. Any other comments.

APPENDIX H

REPORTS ON IN-SERVICE COURSES FOR BIOLOGY TEACHERS
IN KENYA AND MALAWI MARCH AND APRIL 1971

I. KENYA

A. Need for the Courses

In Kenya the SSP Biology had by April 1971 reached Form III in trial schools and teachers were in need of direct in-service help in the interpretation of the course. In particular they needed reassurance about the "discovery" method of teaching and about modern methods of testing and examining.

Teachers of biology in other schools following the conventional course for the Cambridge O-level examination had expressed interest in the SSP philosophy. It was considered that the traditional programme could be taught by means of the discovery method and that those teachers could also benefit by attending an in-service course on this method of teaching and examining.

Therefore arrangements were made to hold a series of one-day in-service courses in four centres in Kenya and to invite all biology teachers in each region to attend.

B. Letter to the Ministry of Education Requesting Permission for the Courses (Copy)

Kenya Institute of Education
P.O. Box 30426,
Nairobi.

18th February, 1971

Ref. No.: 15/2/12

The Chief Inspector of Schools,
Ministry of Education,
P.O. Box 30426,
NAIROBI.

Through The Secretary,
K.I.E.

Biology In-Service Courses

As you probably know, we have with us, for one month, the services of Dr. Rex Meyer of Centre for Advancement of Teaching, Macquarie University Sydney, through Unesco Technical Assistance.

The duties of Dr. Meyer will be to work closely with KIE team dealing with Biology and evaluate the whole of SSP course. He will also help in construction of examination items. Dr. Meyer is particularly suited to perform this task because apart from the fact that he is an expert on evaluation, he was working on SSP Biology for 3 months last year when he was stationed in Tanzania. He was also present during the April writing workshop when we wrote the last volume of SSP course.

We, however, strongly feel that apart from working in KIE, it would be extremely useful if he could talk to biology teachers through a one day in-service course in the four centres listed below.

The centres have been selected in an effort to fit the programme to an earlier scheduled visit to the experimental schools, which will be done in between the one day in-service. As we had a very short time to arrange this programme, it is not possible for us to fit all of the courses on Saturdays. This is the reason why Nakuru and Kisii teachers have to be in-serviced in a week day. It is for this reason that I am asking your permission to allow the biology teachers to have a day off to attend these courses and your co-operation to ensure that these courses are well attended.

It is envisaged that the following time-table will be followed in each of the four centres.

9.00	- 10.15	Introductory remarks - background, philosophy and present situation of SSP Biology in Kenya. Followed by discussion. J.D. Kimura
10.15	- 10.45	Discovery methods in biology teaching. Dr. Rex Meyer
10.45	- 11.00	Tea
11.00	- 12.30	Excursion on school compound to illustrate the role of discovery in biology teaching. Dr. Rex Meyer, Dr. Frank, J. Kimura
2.00	- 3.30	Lecture-discussion on modern methods of examining biology. Dr. Rex Meyer
3.45	- 5.00	Construction of examination questions. Dr. Rex Meyer, J. Kimura and Dr. Frank

Proposed Centres and Dates

1. Nakurux - Nakuru Secondary School : Wednesday, 3rd March, 1971
2. Kisii - Kisii Secondary School : Friday, 5th March, 1971
3. Kisumu - Kisumu Secondary School : Saturday, 6th March, 1971
4. Nairobi - KIE : Saturday, 13th March, 1971

J.D. Kimura

C. The Programme

Kenya Institute of Education Biology In-Service Courses

The Kenya Institute of Education has arranged a series of one-day in-service courses for secondary biology teachers. The emphasis will be on modern teaching methods and on the latest techniques of test construction.

Discussion Leaders:	Joseph D. Kimura	Kenya Institute of Education
	Dr. Sylvia Frank	Kenya Institute of Education
	Dr. Rex Meyer	Unesco Consultant

Programme:

9.00 - 10.15	SSP Biology in Kenya	J.D. Kimura
10.15 - 10.45	Discovery method in biology teaching	G.R. Meyer
11.00 - 12.30	Demonstration of discovery methods using school grounds	G.R. Meyer S. Frank and J.D. Kimura
2.00 - 3.30	Modern methods of test construction	G.R. Meyer
3.45 - 6.00	Workshop for construction of examination questions	G.R. Meyer J.D. Kimura and S. Frank

Centres and Dates:

1. Kisii Secondary School, P.O. Box 11, Kisii.	Friday, 5th March, 1971
2. Kisumu High School, P.O. Box 127, Kisumu.	Saturday, 6th March, 1971
3. Nakuru Secondary School, P.O. Box 661, Nakuru.	Wednesday, 10th March, 1971
4. Kenya Institute of Education, P.O. Box 30231, Nairobi.	Saturday, 13th March, 1971

Name	Initials	Mr., Mrs., Bro. etc.	Teaching SSP Biology Yes/No	Graduate Yes/No	Name of School	Full Postal Address of School
Obondi	D.F.	Mr.	Yes	No	Bishop Otunga	P.O. Box 520, Kisii
Owale	G.C.	Mr.	Yes	No	Kisii School	P.O. Box 11, Kisii
Kanchanld	G. Patel	Mr.	No	No	Kisii Progressive College	P.O. Box 529, Kisii
Ollunga	M.M.O.	Mr.	Yes	No	Kisii School	P.O. Box 11, Kisii
Pesa	J.D.O.	Mr.	Yes	No	Bishop Otunga	P.O. Box 520, Kisii
Sheikh	S.S.	Mrs.	Yes	Yes	Nyabruru	P.O. Box 533, Kisii
Indge	W.J.E.	Mr.		Yes	Kisii	P.O. Box 11, Kisii
Abai	J.O.	Mr.	Yes	No	Nyanchkia	P.O. Box 22, Kisii
Marigi	H.N.	Mr.		No	Renaissance	P.O. Box 379, Kisii
Oburu	K.A.K.O.	Mr.		No	Kereri	Kereri Girls Sec. School, P.O. Box 300, Kisii
Maas	M.	Bro.	Yes	Yes	Bishop Otunga S.S. Mosocna	P.O. Box 520, Kisii
Masese	R.M.K.	Mr.	No	No	Itierio	P.O. Box 50, Kisii
Olale	M.J.	Mr.	No	No	Itierio	P.O. Box 50, Kisii
Osebe	E.W.	Mr.	Yes	No	Nyanchwa	P.O. Box 22, Kisii
Mendes	M.D.	Mrs.	No	Yes	Kisumu Boys High	Box 127, Kisumu
Mendes	A.J.	Mr.	No	Yes	Kisumu Boys High	Box 127, Kisumu
Sehmi	P.S.	Mrs.	No	Yes	Kisumu Girls High	Box 811, Kisumu
Makonyango	C.	Mr.	No	No	Rangala Girls Sec.	P.O. Yala
Orlando-Mallo	E.C.O.	Mr.	No	No	Ramba Sec.	Box P.O. Ndori
Ogoti	N.K.	Mr.	No	No	Ambira Sec.	Box P.O. Ugunja
Obiero	J.O.	Mr.	No	No	Otieno Ogoo	Box 1335, Kisumu
Ogot	T.	Miss	No	No	Nyamira	P.O. Bondo
Trinedi	M.N.	Mr.	No	Yes	D.H.T. School	P.O. Box 723, Kisumu
Thomas	A.	Mrs.	No	Yes	D.H.T. School	P.O. Box 723, Kisumu
Harley	J.W.	Mr. & Mrs.	No	Yes	Nyakach Girls	P.O. Sondu via Kisumu
Ogolla	J.H.W.	Mr.	No	No	Sawagogo Sec.	P.O. Yala via Kisumu
Fitter	S.	Miss	No	No	Siri Guru Sec.	P.O. Box 1580, Kisumu
Kent	H.	Miss	No	No	Siri Guru Sec.	P.O. Box 1580, Kisumu
Gibson	T.H.	Mr.	No	No	Kisumu Day Sec.	P.O. Box 809, Kisumu
Debber	W.	Mr.	No	Yes	St. Mary's	Private Bag, Yala
Alando	S.A.	Mr.	No	Yes	Onjiko Sec.	P.O. Ahero
Mishler	C.L.	Mr.	No	Yes	Ambira Sec.	P.O. Ugunja via Misumu

Name	Initials	Mr., Mrs., Bro. etc.	Teaching SSP Biology Yes/No	Graduate Yes/No	Name of School	Full Postal Address of School
Harper	J.F.	Mr.	No	Yes	Maseno S.S.	Box 120, Maseno
Owino	D.B.	Mr.	No	No	Lwak	P.O. Byilima
Kimotho	J.N.	Mr.			Rift Valley College	Box 280, Molo
Mutisya	J.	Mr.			Bahati School	Box 1648, Nakuru
Njuguna	J.	Mr.			St. Joseph's	Box 1300, Nakuru
Okello	R.A.	Mr.	No	No	Nakuru Day	Box 1179, Nakuru
Mnene	J.T.	Mr.	No	Yes	Nakuru Day	Box 1179, Nakuru
Kamweti	A.	Mrs.	No	No	Nakuru Day	Box 1179, Nakuru
Namwamba	W.J.O.	Mr.				
Mulamula	D.O.M.	Mrs.	No	Yes	Nakuru Day	Box 1179, Nakuru
Kiregu	M.M.	Mrs.	No		Nakuru Sec.	Box 661, Nakuru
Kwambai	J.	Mr.	No	No	Nakuru Sec.	Box 661, Nakuru
Khamba	F.M.	Mr.	No	No	Crater Sec.	Box 69, Nakuru
Johnson	R.P.	Mr.	No	Yes	Nakuru Sec.	Box 661, Nakuru
Galbraith	D.I.	Mr.	No	Yes	Nakuru Sec.	Box 661, Nakuru
Barretto	C.M.	Mr.	No	Yes	St. Xavil's H.	Box 618, Nakuru
Carvalho	A.M.	Mr.	No	Yes	St. Xavil's H.	Box 618, Nakuru
Njenga	G.	Mr.	No	No	Molo Sec.	Box 220, Molo
Lasoi	S.K.	Mr.	Yes	Yes	Tenwek Sec.	Box 3049, Sotik
Kadenyi	M.L.	Mrs.	No	No	Koelel Sec.	Box 151, Gilgil
Kipsige	J.T.	Mr.	No	No	Londiani Sec.	Box 38, Londiani
Waithanji	D.	Mr.	No	No	Michinda Sec.	Box 50, Elburgon
Ngumi	F.	Mr.	No	No	Menengai H.	Box 37, Nakuru
Njoroge	J.G.	Mr.	No	No	Kituro Sec.	P.O. Karbarnet
Mwangi	R.	Mr.	No	No	Baringo Sec.	Box 23, Eldama-Ravine
Gathoga	D.	Mr.	No	No	Naivash Sec.	Box 155, Naivasha
Nguyo	P.	Mrs.	No	No	Menengai Sec.	Box 37, Nakuru
Mumo	J.M.	Mr.	No	No	Mugumo Sec.	Box 152, Molo
Waweru	G.K.	Mr.	No	No	Mugumo Sec.	Box 152, Molo
Kibera	F.J.R.	Mr.	No	No	Mugumo Sec.	Box 152, Molo
Kimotho	J.N.	Mr.	No	No	Rift Valley	Box 280, Molo
Thaper	K.	Mr.	No	No	Jamuhuri	Box 584, Nairobi
Khan	S.	Miss	No	Yes	Jamuhuri	Box 920, Nairobi
Goswani	S.	Miss	No	Yes	Jamuhuri	Box 2027, Nairobi
Alladin	P.	Miss	No	Yes	Jamuhuri	Box 584, Nairobi

Name	Initials	Mr., Mrs., Bro. etc.	Teaching SSP Biology Yes/No	Graduate Yes/No	Name of School	Full Postal Address of School
Gomes	A.	Mr.	No	Yes	Jamuhuri	Box 584, Nairobi
Malik	O.T.	Mrs.	No	Yes	Ngara Sec. School	Box 8248, Nairobi
Stephens	R.M.	Mr.	No	Yes	Nairobi	Box 30047, Nairobi
Huddleston	R.L.	Mr.	No	Yes	Nairobi	Box 30047, Nairobi
Mutsune	M.K.	Mrs.	No	Yes	Highway Sec. School	Box 30385, Nairobi
Wasike	J.M.	Mr.	Yes	Yes	Kamusinga	P.B., P.O. Broderickfalls
Kikaya	D.D.	Mr.	No	No	Parklands	Box 420, Nairobi
Shah	K.N.	Mr.	No	No	Pumwani Sec.	Box 256, Nairobi
Maman	S.M.	Mr.	No	Yes	Easlegh Sec.	Box 2520, Nairobi
Hummel	D.	Mr.	No	Yes	Kenyatta College	P.O. Box 3844, Nairobi
Partridge	G.T.	Mr.	No	Yes	Upper Hill	P.O. Box 30420, Nairobi
Sagoo	J.S.	Miss	No	Yes	Aga Khan	P.O. Box 2171, Nairobi
Pinto	H.	Miss	No	Yes	Loreto Convent	Valley Road, P.O. 1227, Nairobi
Kiara	C.K.	Mrs.	No	No	Jamuhuri	Box 584, Nairobi
Malik	S.B.	Miss	No	Yes	Muslim Girls	Box 1013, Nairobi
Magre	P.	Miss	No	Yes	Muslim Girls	Box 1013, Nairobi
Mogal	F.	Mrs.	Yes	Yes	Ofafa Jericho	Ofafa Jericho Sec., Box 5530, Nairobi
Ellahi	A.	Miss	No	No	Precious Blood Sec.	Precious Blood School, Riruta
Bhurji	J.K.	Miss	No	Yes	Ofafa Jericho	Ofafa Jericho Sec., Box 5530, Nairobi
Vasishta	S.K.	Mr.	No	Yes	Arya Girls	Box 2866, Nairobi
Kapila	R.	Mr.	No	Yes	Ofafa Jericho	Box 5530, Nairobi
Aggarwal	C.P.	Mr.	No	Yes	Dagoretti High	Box 21070, Nairobi
Devani	N.C.	Mr.	No	Yes	Highway Sec.	Box 30385, Nairobi
Neanga	K.W.	Mrs.	No		Pumwani Sec.	Box 256, Nairobi
Stevens	R.D.	Mr.	No	Yes	Machakos	Box 39, 25 Machakos
Loudon	C.M.	Mrs.	Yes	Yes	Machakos	Box 39, Machakos
Osborn	R.M.	Miss	Yes	Yes	Alliance Girls	Box 109, Kikuyu
Nderi	P.N.	Mr.	No	No	Njiris	Box 555, Thika

E. Follow-up Letter to Schools

Kenya Institute of Education,
P.O. Box 30231,
Nairobi.

Ref.: No. 15/2/12

24th March, 1971

In-Service Course for Biology Teachers

On behalf of Mr. Joseph Kimura, Dr. Rex Meyer and myself I am writing to express our gratitude to you for your efforts in bringing together biology teachers in your area for our one-day in-service course. We were fully aware of the difficulties you had, working on such short notice, and feel gratified that so many teachers were able to attend. As you know, Dr. Meyer was in Kenya for a very limited period. But because of your efforts, he was able to meet and teach over one hundred biology secondary school teachers in Kenya during that very short space of time. We feel most gratified.

Yours sincerely,

Dr. Sylvia Frank
for Secretary,
Kenya Institute of Education

F. Appraisal

Approximately 100 teachers attended the course representing about one-third of the biology teachers in Kenya.

The course was well received and the teachers responded to the challenge of the "discovery" method. Most found the method new and a number was concerned about the time it takes to develop concepts when using this approach. They were reassured, however, by being encouraged to adopt it wherever and whenever possible rather than being given a compulsory directive.

There was a great deal of interest in the workshop for writing examination questions. The aim of the workshop was not to train the teachers in writing multiple choice objective questions but to give them some insight into the rational of objective testing for understanding rather than for memory work. Most teachers enjoyed setting questions which, incidentally, were generally of a satisfactory standard.

On the whole the courses must be judged as being highly successful.

II. MALAWI

A. Need for the Course

In contrast to the Kenya course the in-service programme in Malawi was designed only for the six teachers in the five schools using the Unesco Pilot Project Units in trial forms.

The course was organised in order to give special training in the field work necessary for Unesco Unit 10 "Living Things and Their Environment" and to consider teaching problems associated with Unit 10. Another aim was to give the teachers an insight into the rationale of objective testing and to give them some experience in writing multiple choice items testing for understanding. A central objective was to consider the format the Unesco booklets were to take in their final edition. There was confusion in the materials about whether or not the units were to be used as texts, workbooks, background readers or combinations of these. A central objective of the course, therefore, was to design a suitable format for the Malawian edition of the books and teachers' guides. There was need too for some consideration of methods to be used in obtaining feedback from trial schools for the final re-writing of the Unesco materials.

The Ministry of Education therefore arranged leave for Unesco Pilot Project teachers to attend a full-time four-day course at Chancellor College under the leadership of Mr. Stan Moss, Inspector in Charge of Science, and Dr. G.R. Meyer, Unesco Consultant. The course was held from Tuesday, 13th April to Friday, 16th April, 1971.

B. The Programme (see over)

Unesco Biology Pilot Project Workshop Programme April 13 - 17, 1971

Tuesday, April 13	Wednesday, April 14	Thursday, April 15	Friday, April 16	Saturday, April 17
8.30 Introduction. Review of project to date 9.30 Can we really teach by the discovery method? 10.15 COFFEE 10.30 Demonstration of the discovery method followed by discussion	8.30 Workshop to produce materials (continued) 10.15 COFFEE 10.30 Consideration of methods of obtaining effective feedback for revision of Unesco booklets	FIELD DAY AS AN INTRODUCTION TO UNESCO UNIT 10 8.30 Discussion of general field methods 9.30 Overview of content of Unit 10 10.00 COFFEE 10.15 Excursion to grassland and forest at Maone	8.30 Discussion of teaching problems associated with Unesco Unit 10 10.15 COFFEE 10.30 Rules for writing multiple-choice questions : a discussion	Optional 12.00 Course concludes
12.00 - 1.30 LUNCH	12.00 - 1.30 LUNCH	1.00 - 2.30 LUNCH	12.00 - 1.30 LUNCH	
1.30 Problems of Unesco booklets in the present form: ways of overcoming problems (a discussion) 2.30 Beginning of workshop to produce materials in light of discussion 4.00 Conclude session	1.30 Construction and application of questionnaire to obtain feedback 4.00 Conclude session	2.30 Assembly and discussion of results of field excursion 4.00 Conclude session	1.30 Workshop to write items for unit tests for Unesco booklets 4.00 Conclude session	

C. List of Teachers Attending

Course Leaders :	Mr. Stan Moss	Inspector of Science Teaching, Ministry of Education
	Dr. Rex Meyer	Unesco Consultant in Biology Teaching

Teachers :

Mr. Z. Chirambo, Dip. Agric.,
Malosa Secondary School,
P.O. Kasupe.

Mr. D. Kayira (Dip.),
Chiradzulu Secondary School,
P.O. Box 20,
Chiradzulu.

Mr. I. Medi, B.Sc.,
Blantyre Secondary School,
P.O. Box 373,
Blantyre.

Mrs. F. Mbale, B.Sc.,
Soche Hill Secondary School,
P.O. Limbe.

Mr. A. Mkandawire (Dip.),
St. Patrick's Secondary School,
P.O. Box 5450,
Limbe.

Mr. M. Zoani, B.Sc.,
Soche Hill Secondary School,
P.O. Limbe.

D. Appraisal

The objectives were largely achieved. Considerable time was spent discussing the format the Unesco books should take in the final re-writing. It was agreed that consumable workbooks would be educationally ideal but too costly. It was agreed therefore to develop the books in the workbook style but with all responses to be written into an exercise book.

Unit I was selected for a prototype revision and it was decided to write section 4 "Grouping Things", pages 3 to 13, as a sample of a proposed new layout. A Teachers' Guide for this section was to be produced at the same time. The Pupils' Book and the Teachers' Guide would follow the same pattern for each section of each unit and would have the following structure:

Pupils' Book

1. Objectives for section

2. Detailed procedures for investigations

   Investigations to be varied, e.g. an experiment; a field study; a demonstration; a discussion; analysis of a reading passage (e.g. quotations, magazine extract, text, newspaper article, illustrations, etc.); or analysis of audio-visual material.

3. Questions based on investigations to be answered by pupils

   (At this point teacher would develop a summary)

4. Background reading

5. Discussion questions on background reading

   (At this point teacher would discuss section as a whole)

6. Unit test at end of complete unit.

Teachers' Guide

1. Objectives of the section

2. Background information (where necessary)

3. Method of introducing the lesson

4. Hints on the investigation)
5. Answers to questions in investigation) to be repeated for each investigation
6. Hints on summary to be given by teacher)

7. Teaching about the background reading

8. Answers to questions on background reading

9. Hints on how to conclude the section

The teachers undertook this work with enthusiasm and the prototype materials were produced. They will be used as models for the revision of the rest of Unit I and for all other units. These prototype materials are given in this report as Appendix I.

See Appendix I

Another especially successful aspect of the course was the training in field methods. A comprehensive Teachers' Field Guide was prepared for a given area of grass and timber to introduce teachers to as many simple field methods as possible. This guide is given in this report as Appendix J.

See Appendix J

The teachers completed all the assignments in the study guide and were amazed and impressed at the vast amount of useful information that was collected by means of the simple methods advocated. It was then a simple matter to decide which aspects of Unesco Unit 10 would be appropriate for Forms I and II in Malawi.

The workshop on item writing was well received and some good questions were set. Techniques for obtaining feedback for revision of the books were also discussed and some simple methods approved for later implementation.

The work on the discovery method was received sympathetically indicating a general approval and acceptance of this method of teaching.

The course therefore satisfactorily achieved its aims, and appeared to be most successful.

APPENDIX I

SAMPLE LAYOUT FOR PUPILS' TEXTBOOK AND TEACHERS' GUIDE
UNESCO BIOLOGY FORMS I AND II - MALAWI

Prepared by Unesco Local Study Group as Basis for a Revised Edition for Malawi of Unesco Pilot Project for Africa, April 1971

TEACHERS' GUIDE

SECTION 4 - GROUPING THINGS

1. Objectives

a. Observe external features of living organisms around the school or from pictures and group them according to external features using their differences and similarities.

b. Note external features of organisms grouping animals in a table according to their structures.

c. Construct a branched grouping chart.

d. Explain how groupings of this kind are of value in biology.

2. Background Information

Earlier than Fifth Century B.C. some men had realised the need for grouping things and they tried to group living things broadly. By Fifth Century B.C. Aristotle (a Greek Philosopher and Biologist) and his pupils attempted grouping organisms (plants, for example, were grouped into shrubs, trees, and herbs and animals into land animals and water animals).

As more organisms were found there was need to find a much more detailed way of grouping them since the old system became inadequate. Thus by Eighteenth Century A.D. a number of biologists including Carolaus Linnaeus constructed a much better grouping chart which has now become even more elaborate. This grouping is based on external features of organisms since these are easy to observe and do not change. It was realised that variable characteristics such as age, sex, colour or size could not be used as a basis for classification.

3. Introduction to Lessons

Tell pupils how different people arrange their things. For instance, librarians put books of the same subject together so that he can serve students quickly.

A good shopkeeper does not mix his things together. For example, he does not put plates with clothes, neither does he mix foodstuffs with soap nor washing soap, e.g. Omo with bathing soap, e.g. Lifebouy.

He puts similar things together in groups and knows where each group is kept. This helps him serve his customers quickly.

Let us now look at the things in our classroom and try to put them into groups as a good shopkeeper does.

4. Hints on Investigation 4.1

Prior to the investigation the teacher must choose the nearest and most suitable habitat to the school.

The teacher must acquaint himself/herself with the living things in the habitat. If possible, the teacher should try to be familiar with the names of the living things around the school.

Pupils should construct Table 4.1 before they leave for the habitat.

Before the investigation the teacher must collect a few examples of plants and animals to be used in the summary of the investigation.

5. Answers to Questions After Studying the Results Under Investigation 4.1

a. Animals and plants.

b. Answer depends on living things available in the habitat, but may include fungus, alga, lichen, liverwort.

6. Hints on the Teachers Summary of Investigation 4.1

Living things in Group I are animals and those in Group II make up most of the plant group. Both the animal group and the plant group can be sub-divided into smaller groups.

7. Hints on Investigation 4.2

Note : Collecting animals and grouping them may not be done in one day due to shortage of time. In such cases, the animals should be preserved in 5% formalin or 10% alcohol or be pinned out till the next lesson.

Pupils should be divided into groups of 8.

The pupils collections should be examined and if necessary you can increase the variety by collecting more or adding stored specimens, e.g. spiders, butterflies, earthworms and centipedes. Let pupils group their animals using their own methods. Stress the importance of the words "Differences and Similarities".

8. Answers to Questions After Studying Results Under Investigation 4.2

Answers 1-4 depend on the class's collection.

9. Hints on Teachers Summary for 4.2

Discuss the merits and demerits of different characteristics, e.g. colour, sex, size or age differences for grouping. Bring out the value of using structural characteristics which are easily observed and do not change.

10. Summary

It is very important when grouping living things to use characteristics which are easily observed and do not change.

11. Hints on Investigations 4.3

Additional pictures (photographs) should be obtained by cuttings from magazines or any other source to supplement those in the pupils book.

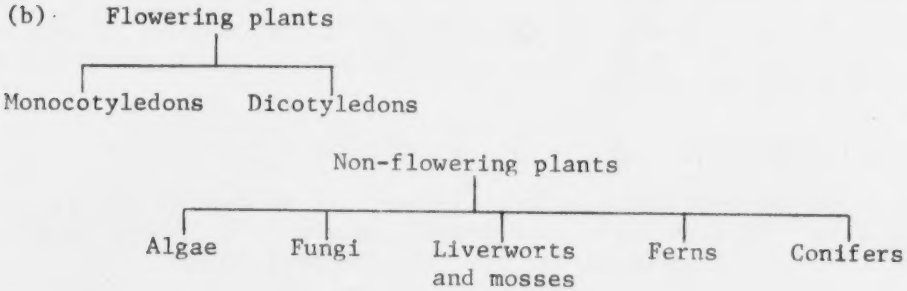
The collection of specimens for the wall chart could be done as a class assignment, i.e. pupils should make their collections during their own free time and not during biology class time. Plant specimens should be collected and brought to class in plastic bags or between sheets of newspaper.

A similar chart like the one on plants could be constructed for animals.

12. Answers to Questions on Investigation 4.3

I (a) i Flowering plants
ii Non-flowering plants

(b)



II (a) Flowers
(b) Veins on leaves
(c) Roots (present or not)
(d) Chlorophyll (present or not)
(e) Type of stem

III They are easy to observe and do not change.

13. Hints on Teachers Summary for Investigation 4.3

Here again sorting into groups must be based on structural differences and similarities, e.g. presence or absence of stem, leaves and flowers and roots. Bring out the value of using structural characteristics which are easily observed and do not change.

14. Summary

As in investigation 4.2, it is important when grouping plants to use characteristics which are easily observed and do not change.

15. Teaching About Background - Reading Section

The background reading is there to give pupils some useful information and emphasize the important aspect about classifying living things.

This passage give information about John. It should give pupils an understanding of the use of a classification system. If we know the group to which an organism belongs, we know a lot about its characteristics.

16. Answers to Questions on Background Reading

I (a) He has finished primary school and is in the top 10% of primary school graduates.

(b) That he has completed Form I and that he is preparing for the J.C. exams and that he is aged probably between 15-19 years of age.

(c) If the school is streamed we can say that he is above average ability for his form, and that he stands a good chance of passing the J.C. examination.

II Yes

(a) Some cassava is poisonous. Some types of maize are of poor quality.

(b) Some snakes are poisonous.

(c) Some fish are good to eat. Knowing which group these things are in is therefore helpful.

17. References

East African Junior Biology by J. Savory (Nelson)

Biology Charts by M. Moss

Unesco Biology Filmloop - Collecting Insects

Time-Life Nature Series (selected titles)

18. Discussion Questions on Section 4 - Grouping Things

I Which types of characteristics are most suitable for grouping living things?

II How would you construct and use a branched grouping chart?

III Why is grouping of living things of use in biology?

Answers to the above questions summarize the section as follows:

I The most useful characteristics for grouping living things are structures and features which do not change.

II Differences and similarities can be used to divide animals and plants into two primary groups. Each of these groups can be further divided using structures which do not change. If necessary each sub-group can be further divided.

III By grouping living things we gain a knowledge about each group and the relationships between groups. Also if we know to which sub-group an organism belongs it tells us a lot about its characteristics.

PUPILS' TEXTBOOK

SECTION 4 - GROUPING THINGS

Objectives

1. Observe external features of living organisms around the school or from pictures and group them according to external features, their similarities and differences.

2. Note external features of organisms, grouping animals in a table according to their structures.

3. Construct a branched grouping chart.

4. Explain how grouping of this kind are of value in biology.

Investigation 4.1 : Grouping of Living Things

Materials - notebook and pencil

Procedure

1. Go out into some uncleared area around the school.

2. Write down the names of as many living things as you can observe in the selected area in the table similar to the one shown below. (Use an English or local name or if you don't know it, make up your own).

3. For each living thing put a tick or a cross to show whether it has or has not wings, legs, green colour and whether it is fixed in one place or can move from place to place. The first one is done for you as an example.

Name	Wings	Legs	Green Colour	Leaves	Fixed	Can Move From Place to Place
Butterfly	✓	✓	×	×	×	✓

4. Look at your table above and sort the living things into two groups:

   Group I - wings or legs and can move from place to place
   Group II - green colour, leaves and fixed

Studying Results

1. What are the two main groups of living things you have found?

2. Are there any other living things that could not be put in either of the two main groups you named in Q.1 above? If so, mention a few examples.

Note: Summary provided by teacher.

Investigation 4.2 : Grouping Animals

Materials - insect net
forceps
killing bottles
specimen jars

Procedure

1. Collect as many different types of animals as you can by using a sweep net.

2. Use your net to catch flying insects such as butterflies, grasshoppers and beetles.

3. Using forceps if necessary, collect as many crawling animals as you can.

4. Put all the animals you collect in the killing bottles.

5. Take all the animals you have collected to the laboratory and examine them by looking at the features indicated in the table below.

Name of Animals (if known)	Body Regions	Number of Legs	Number of Wings	Other Features	Major Groups
Grasshopper	3	6	4	Long narrow wings	GROUP 1
Butterfly	3	6	4	Wide decorated wings	Name: INSECTS
					GROUP 2 Name:
					GROUP 3 Name:
					GROUP 4 Name:

Studying the Results

1. How many main groups have you got?

2. What characteristics have you used in sorting out these animals into groups?

3. What type characters appear to be the best for grouping these animals? What are the main reasons for your suggestion?

4. What are the common characteristics of each group?

Note: Summary provided by teacher.

Investigation 4.3 : Grouping Plants

Materials - notebook, pencil, hand lens, knife, plastic bags.

Procedure

1. Carefully observe the pictures on the following pages

2. Using a similar table as the one shown below, fill in the table the names of the plants, indicating whether the stem is present or absent, leaves are present or absent and whether the plant produces flowers or not.

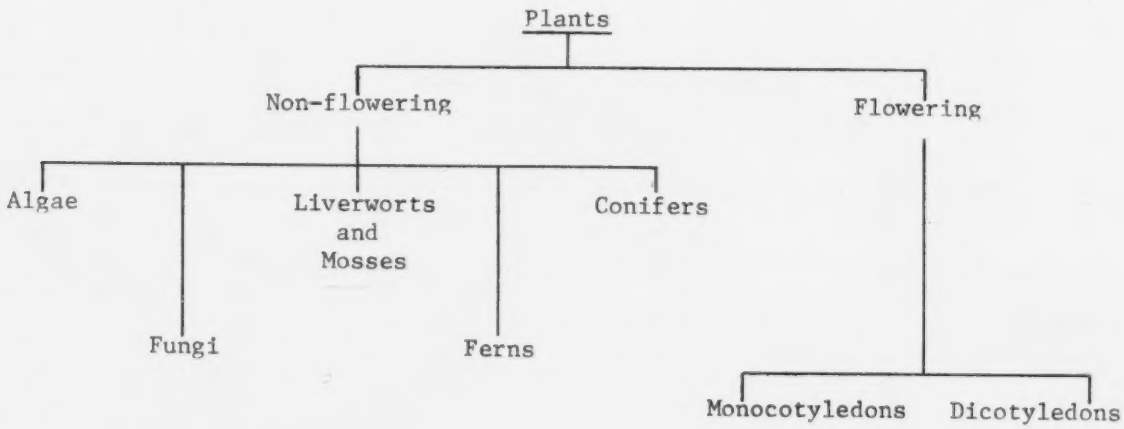
Name	Stem Present / Absent	Leaves Present / Absent	Plant Produces Flowers / Plant Does Not Produce Flowers
Fern			
Sunflower			
Liverwort			
Guava			
Lichen			
Moss			
Pine			
Brown strap weed			
Hibiscus			
Grass			
Euphorbia			
Mushroom			

Pictures:

FERN	SUNFLOWER
LICHEN	MOSS
HIBISCUS	GRASS

LIVERWORT	GUAVA
PINE	BROWN STRAP WEED
EUPHORBIA	MUSHROOM

3. Copy the following chart into your notebook and under each group list the names of the plants from your table above.



4. Over the next few days collect as many plants of each group shown on the chart as you can. The pictures on 117 will help in your grouping.

As a class project make one large copy of the chart above. All members of the class should attach the plants collected under the correct groups on the chart.

Studying Results

1. What are the two major groups of plants? Under each major group list the sub-groups.

2. What common characteristics did you use in grouping the plants on your chart?

3. Why did you decide to use these characteristics.

Note: Summary provided by teacher.

Background Reading - Classifying a Boy

It is important to put living things into groups because one can know a lot about a particular type of plant or animal without actually seeing it.

Imagine a visitor comes in the school and asks about a certain boy called John Kayini. He is asked the form (class) the boy belongs to. The visitor says, "he is in Form II." He is again asked if John belongs to Form II A or II B. The visitor says, "he is in Form II A."

From the above information it is easy to know a lot about John Kayini even without seeing him.

Discussion Questions on Background Reading

1. (a) John Kayini is in the secondary school. What does this tell you about John?

   (b) What does being in Form II tell you about John?

   (c) What does being in Form II A tell you about John?

2. Is this system of grouping useful to other living things as well? For example

   (a) Maize or cassava

   (b) Snake

   (c) Fish

   Explain your answer in each case.

DISCUSS IN CLASS THE IDEAS IN THE SECTION.

APPENDIX J

A STUDY OF ADJACENT AREAS OF GRASS AND TIMBER

A Guide for Biology Teachers

Fact: The canopy of the trees in the area to be studied allows sufficient light to reach lower levels to support climbers, shrubs and herbs. Grassland lacks trees and shrubs.

Our aim is to test the following hypotheses:

SET I. The Vegetation

i) Lower layers of timbered area are darker, cooler, and more moist than equivalent layers in the grassland. They are more protected from the drying effects of sun and wind.

ii) Plants in a timbered area therefore are in a more favourable environment than plants in an open area of grassland and will be more diverse.

iii) Across the boundary zone between the trees and the grass the environment will change from a cool moist and dark place to a hot, dry bright place. As this change occurs there will be corresponding changes in the nature of the vegetation. Plants resisting hot, dry conditions will survive in t he grassy area.

iv) A critical factor in the timbered area will be access to light, therefore plants there will have adaptations to get maximum light.

v) A critical factor in the grassland will be periodic shortage of moisture so plants will have adaptations to resist dryness or to survive during dry conditions.

SET II. The Soil

vi) Because of the more abundant vegetation and the larger leaves in the tree community the litter and humus layer of the soil will be moister, cooler and richer in organic content than the surface soils of the grassland.

vii) Because, under dry conditions, decomposition is slow, the litter layers of the grassland will have a higher proportion of larger leaf fragment than in the timbered area. The organic acids in forest litter will therefore be greater than in grassland litter. ∴ pH of soil in tree area will be lower than pH soil in grassland area.

SET III. The Animals

ix) Because of the more "favourable" environmental conditions of the stand of trees, animals in the herb and litter layers there will be more diverse than those in equivalent layers of grassland.

x) The place with best environmental conditions and most food is the litter and humus layer of the forest. This will therefore support the most diverse population.

xi) The only animals present in large numbers in the grassland will be those adapted to hot dry conditions.

xii) Animals in the herb layers will be adapted for rapid movement through open spaces and for clinging to vegetation.

xiii) Animals in the litter layers will be adapted for rapid movement through thin horizontal spaces and for burrowing through soil and litter.

SET IV. Other Hypotheses

Add further hypotheses that occur to you as we proceed with the excursion.

PART I. Plotting Vegetation

The following maps, tables and graphs should be prepared.

1. Location Map showing distribution of vegetation. Using the contoured map provided plot in the approximate distributions of types of vegetation. It will be helpful to stand on one or two places on high land to give views of the whole area.

2. Preparation of Transect

Choose a typical location in the centre of the grassy area and another towards the centre of the clump of trees. The two locations should be 50 yards apart and the land between should be reasonably level. Using two 1 yard sticks walk along the transect marking out 1 yard squares. At every third square estimate percentage cover of dominant species and total percentage cover filling in the table provided. At squares 1 and 25 drive in stakes clearly labelled as stations I to III. These stations will be places for further observations later.

Back in the laboratory, prepare a bar graph for each species showing percentage cover against distance along transect. Use the grid provided.

3. Drawing a Profile

Stand on a high point some distance to one side of the transect so you can scan the whole length of the line and clearly see stations I to III. Estimate the height of the tallest tree along the transect and mark that as the maximum height on the profile chart provided.

Using the symbols shown on the profile chart draw the side face of the vegetation along the line of the transect. Use the axes provided.

The table of percentage cover of dominant plants will be useful in showing exactly where various kinds of plants begin and end along the

line. Show relative heights of plant types to a rough scale.

The drawing should clearly show i) any evidence of layering or strata in the vegetation, ii) zones of dominant plant types, iii) nature of the canopy, iv) presence of epiphytes and climbers.

Use coloured pencils.

Collect representative plants of each type and take them to the laboratory.

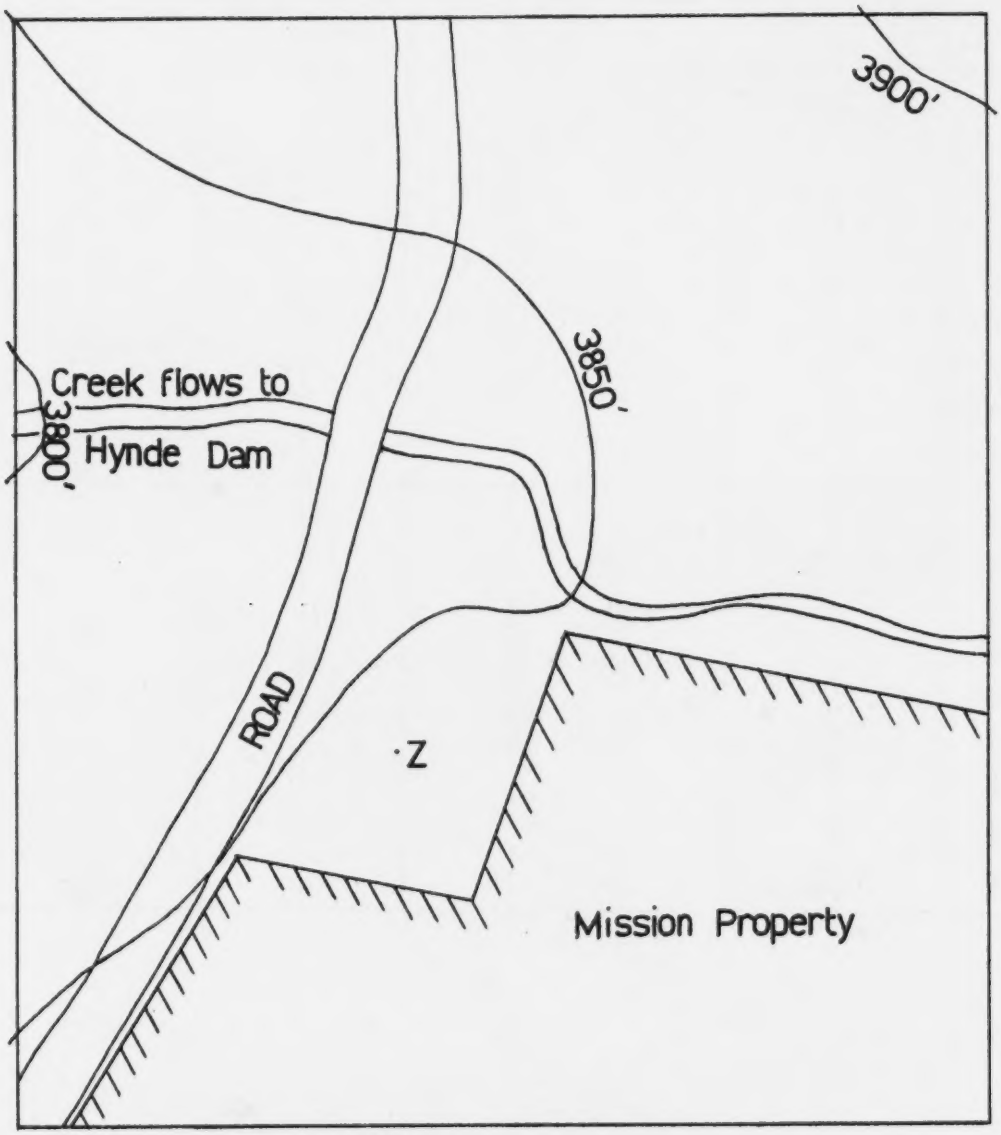
4. Surface Maps of Canopy Cover

For specified areas of vegetation draw in the cover provided by herbs, grass, shrubs, trees and climbers using the key provided. You must look both down on the low vegetation and up at vegetation overhead. Draw what would be the areas of shadow cast by the various types of canopy when the sun is immediately overhead. Many vegetation types will overlap.

EXCURSION AREA - STUDY OF GRASS AND TIMBER.

MAP REFERENCE: Blantyre-Limbe 1535C3
Grid Reference=216525
for Point Z (Approximate)

COMMUNITIES
LOCATION MAP AND
DISTRIBUTION OF VEGETATION



Scale = 100yards

Use the following Key to mark in areas of vegetation.

= MAINLY GRASSES

= MAINLY CULTIVATED TREES (BLUE GUM)

= TREES NOT CULTIVATED

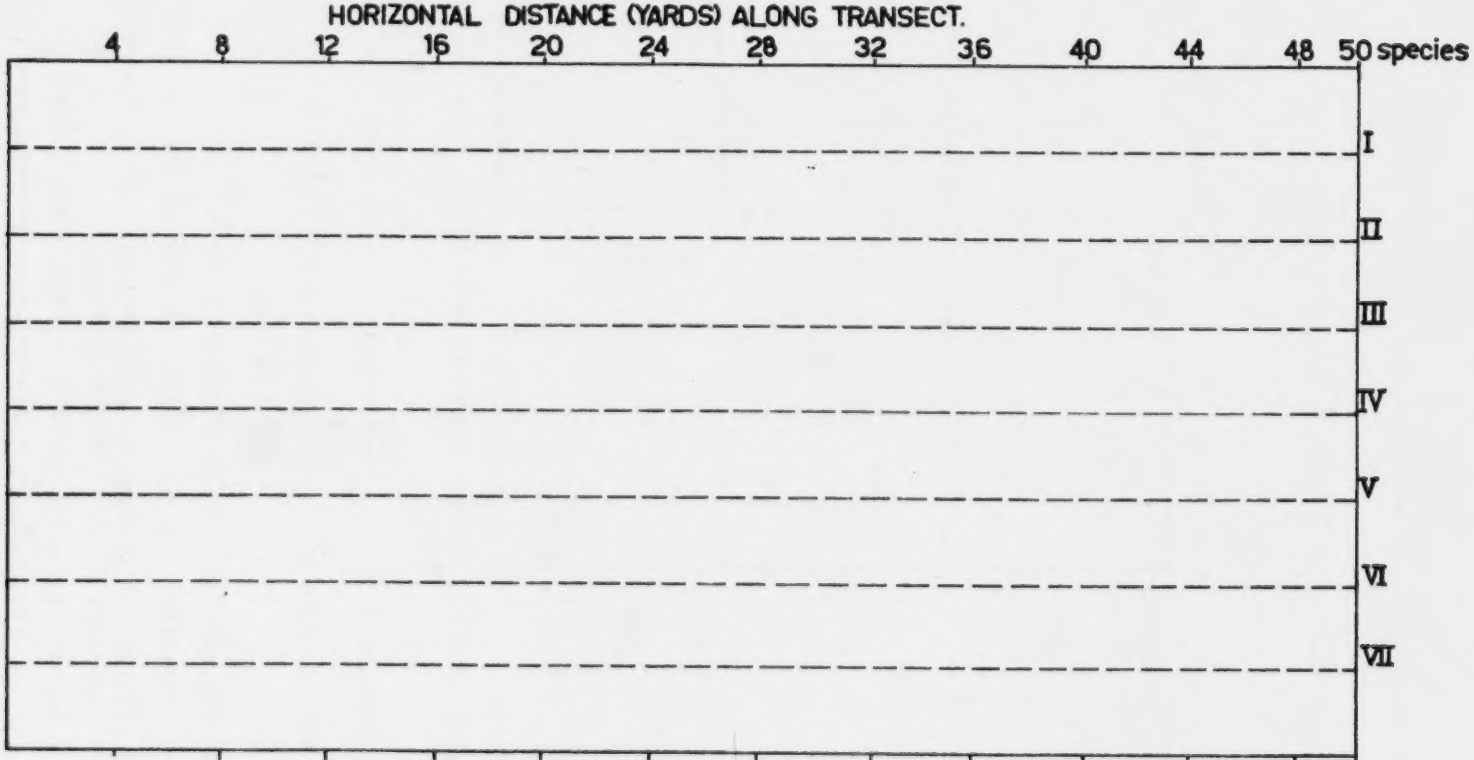
= CULTIVATED CROPS (SPECIFY)

PERCENTAGE COVER OF DOMINANT PLANTS ALONG GRASS TO TIMBER TRANSECT

Square Number (yards)	Grass I	Tobacco type	Tree	Grass II	Malva type	Morning Glory type	Sedge type	Total Cover	Location of Stations
1									I
3									
6									
9									
12									
15									
18									
21									
24									II
27									
30									
33									
36									
39									
42									
45									
48									
50									III

Distribution of Dominant Plants

Using the dotted lines as centre lines plot the percentage cover of each species against distance along the transect. Use the key shown below. Use colours.

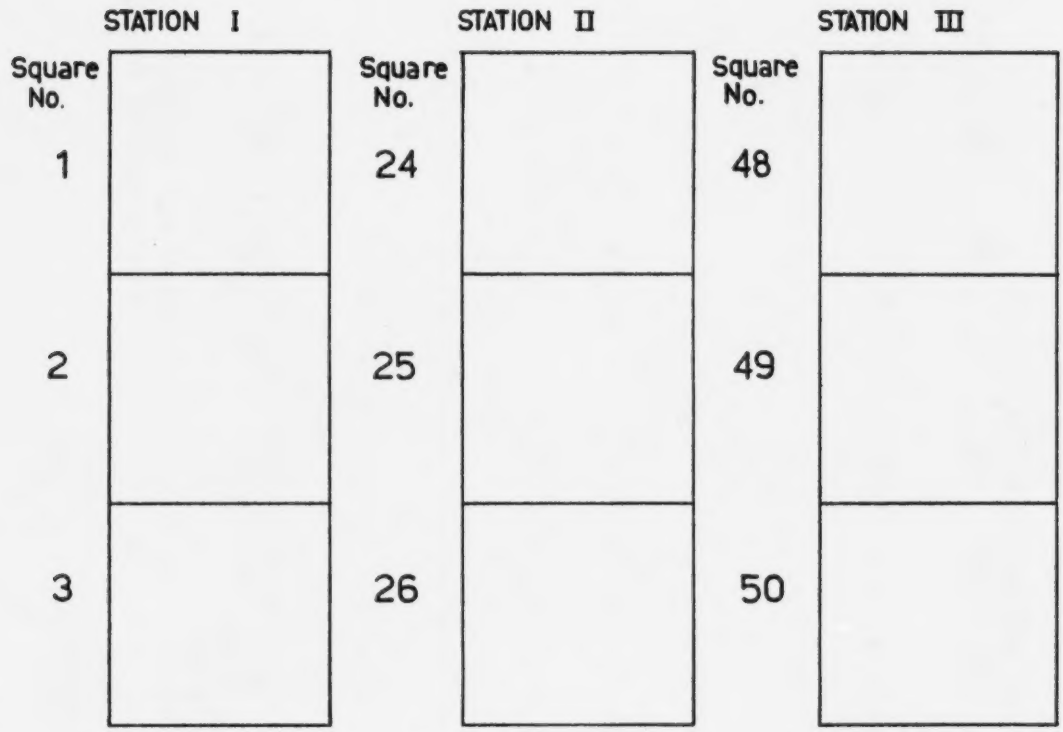


KEY PERCENTAGE	DENSITY	Type of Bar for Graph
0	Nil	None
1-25	Slight	———
25-50	Thin	———
51-75	Thick	———
76-100	Dense	———

Label each bar graph with the name of the plant.

Surface Maps of Type and Cover of Canopy at Three Stations Along Transect

(Each Map is of an Area 1 Yard x 3 Yards)



Show areas covered by the following types of vegetation. Use the key shown.

Key

= Herb, soft to 2'

= Tall grass, above 2'

= Shrub soft or woody 2 - 6'

= Tree, woody, above 6'

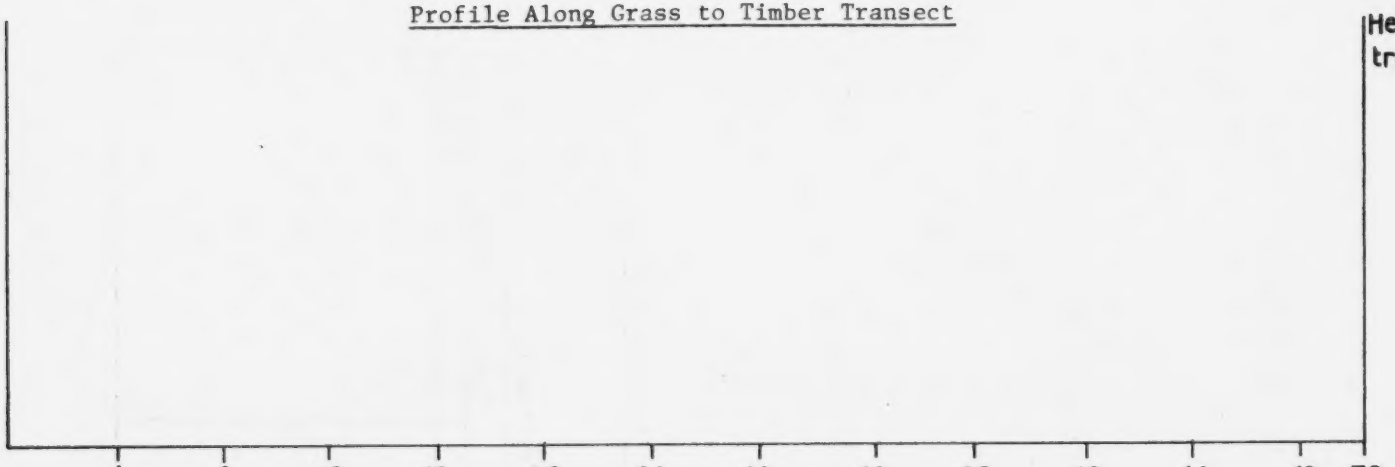
= Climber

Answer the following questions about these three maps.

1. What types of vegetation are most common at each of the stations?
2. The types of vegetations overlap in distribution. What does this show about vertical layering in the communities?
3. Which station has the greatest variety of vegetation types?
4. Describe any major differences between Stations I, II and III shown by these maps.

Profile Along Grass to Timber Transect

Height of tallest tree=



Station I Station II Station III

Draw a side view of the vegetation using the reference guide provided above.

Indicate the type of vegetation by means of the following key.

Tall grass (above 2') =

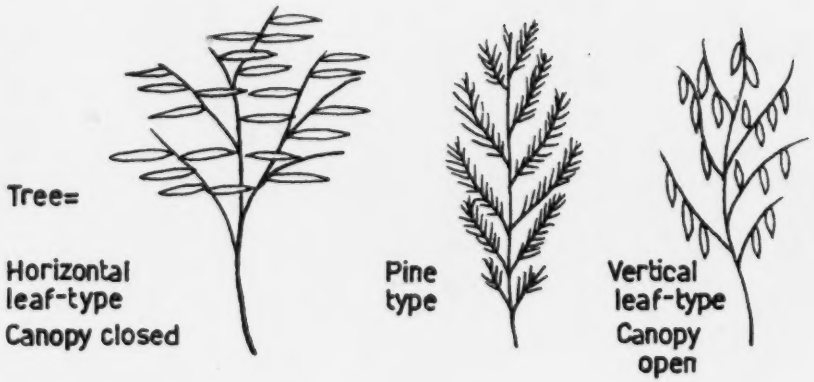
Short grass =

Herb =

Shrub =

Climber =

Epiphyte =



Questions about Vegetation

1. To what extent can the features of the location and plant distribution map be explained by the work of man?

2. Can you suggest some ways that the vegetation may have been influenced by the creek and by the contour of the land?

3. From your tables and graphs, name the station (I to III) which has

   i) the densest cover of vegetation
   ii) the greatest variety of plants
   iii) the tallest plants
   iv) the greatest number of layers

4. Before you make further observations predict which station would be

   i) coolest
   ii) hottest
   iii) most moist
   iv) least moist
   v) having highest light intensity
   vi) having lowest light intensity
   vii) having thickest layer of litter and humus

   In each case give your evidence.

PART II

Conditions of the Environment at Stations I to III

1. Nature of Vegetation

   Also refer to transect, profile and canopy maps.

Feature of Vegetation	Station Number		
	I	II	III
Dominant type			
Height of tallest plant (ft.)			
Average height (ft.)			
% cover			
Canopy closed or open			
Number of species			

2. Weather or Climate

Weather	Height in Feet	Station Number		
		I	II	III
Temperature (^{o}C)	+6			
	+2			
	0			
	-2			
Dryness (time in seconds for cobalt chloride paper to change)	+6			
	+2			
	0			
	-2			
Light intensity (light meter units)	+6			
	+2			
	0			
Exposure to wind (5 max. to 1 min.)	+6			
	+2			
	0			

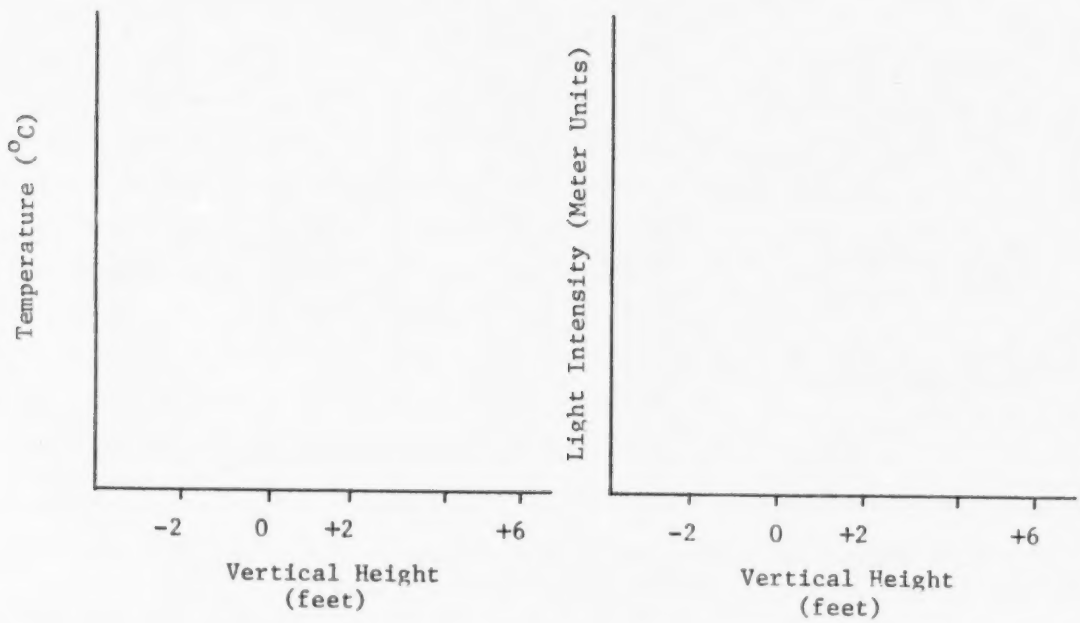
Plot changes in temperature, light intensity, wind exposure and dryness against vertical height for Stations I and III.

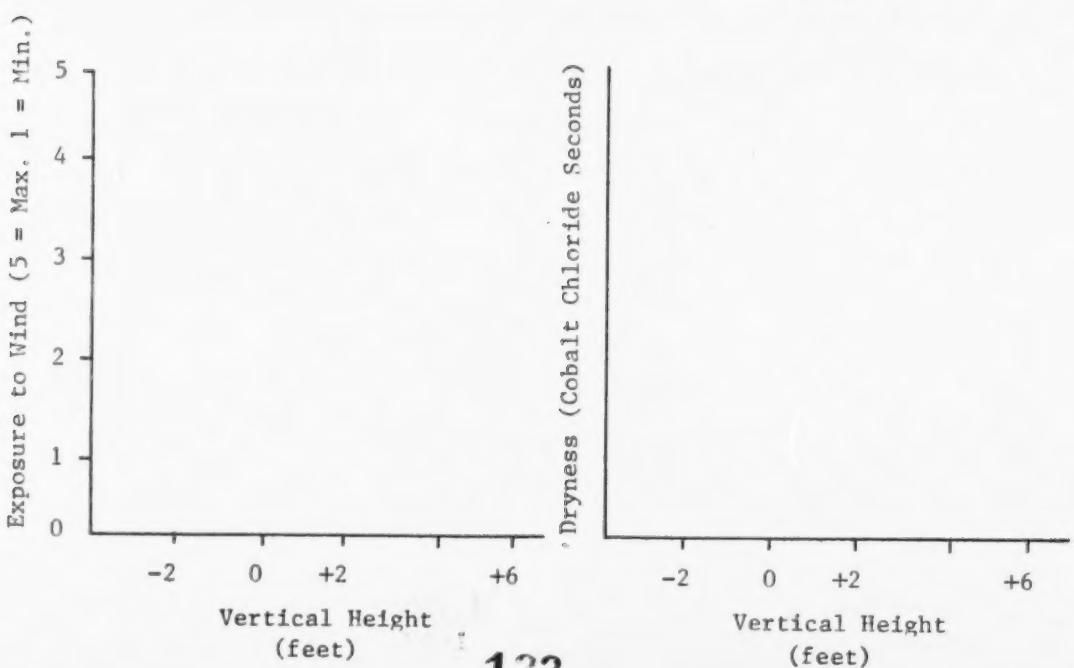
Use the following axes joining points by straight lines.

Use the following key - - - - - - = Grass Community (I)

_____ = Tree Community (III)

Graphs Comparing Weather at Stations I and III





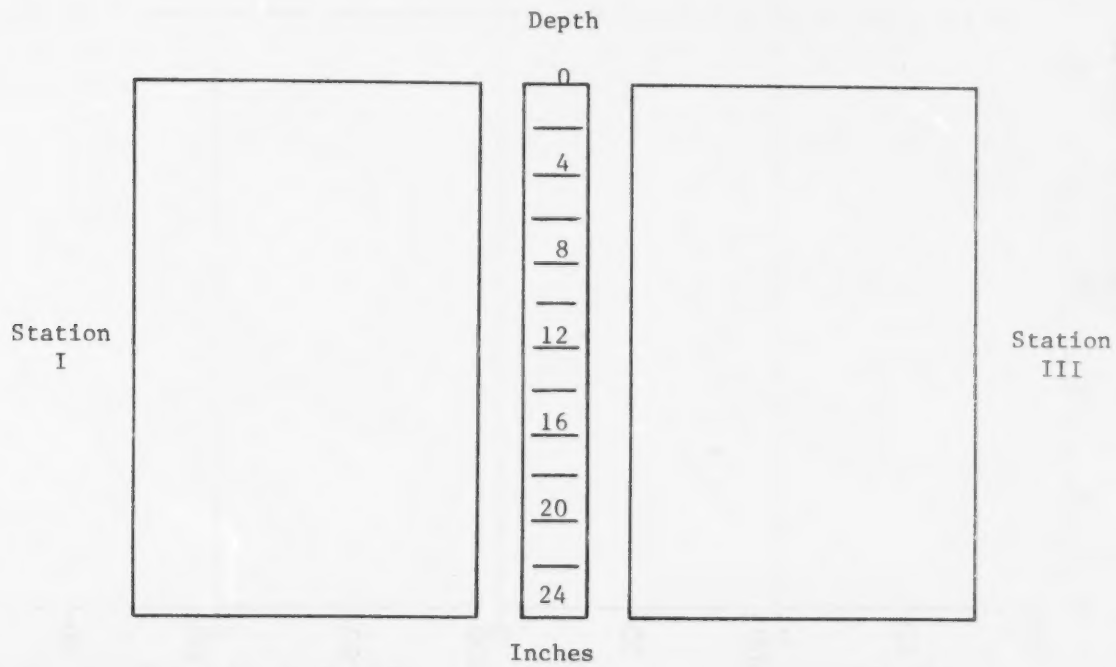
3. Soil

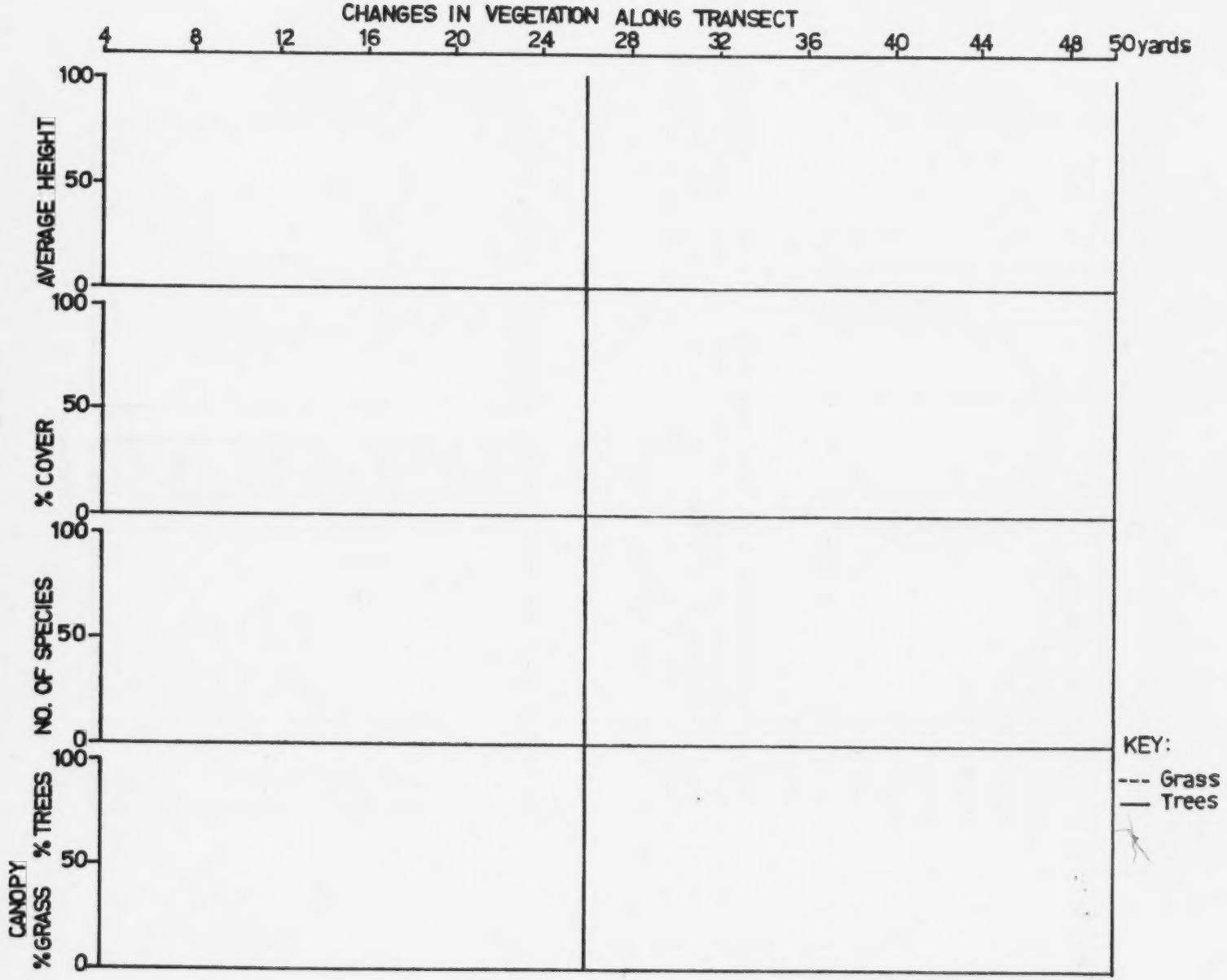
(a) Soil Properties Stations I to III

	Station Number		
	I	II	III
% cover surface litter			
Depth of humus (inches)			
Dryness at -1"			
Dryness at -2'			
pH surface litter			
pH at -1"			
pH at -2'			

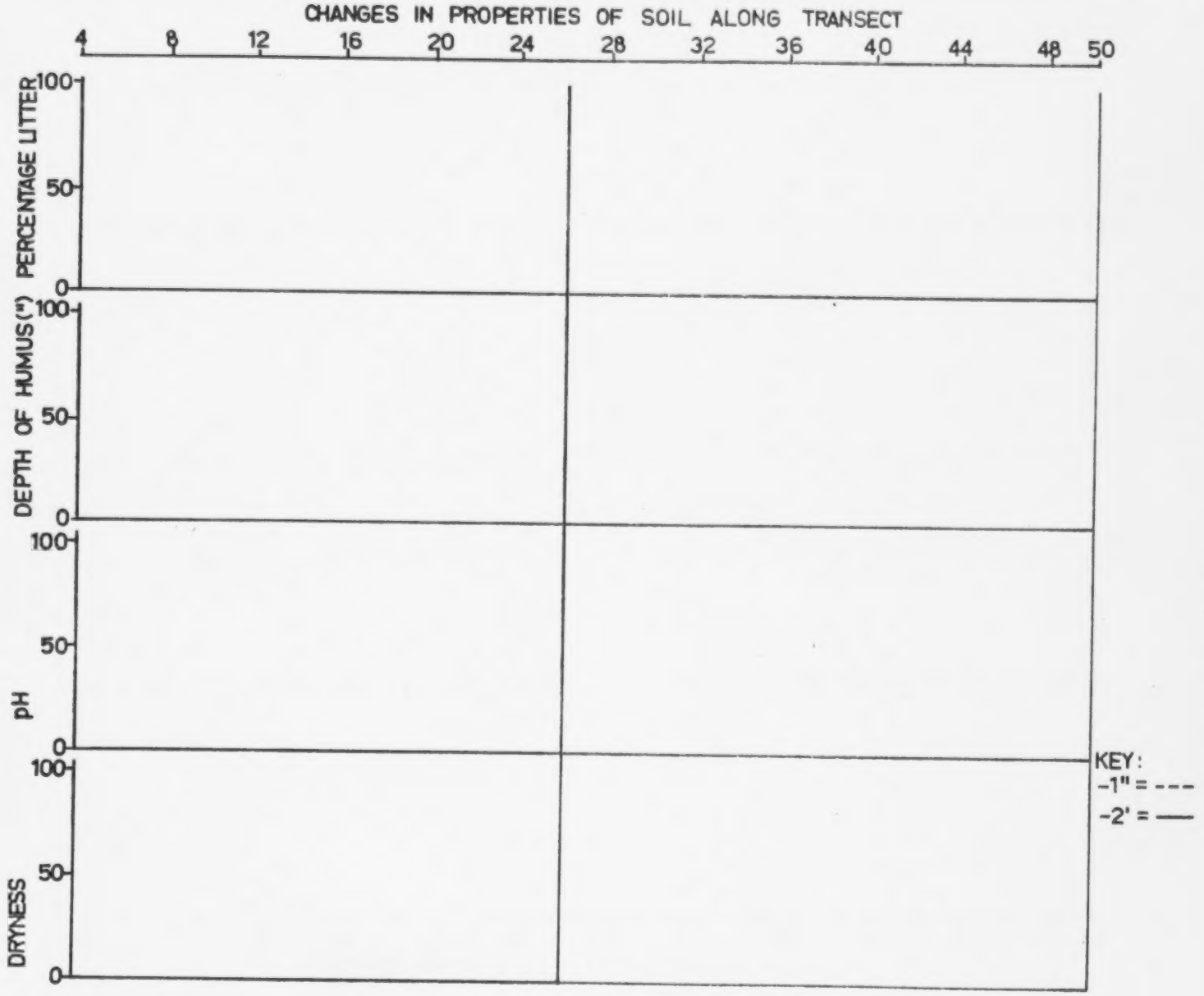
(b) Soil Profiles

In the following spaces draw the clean face of a two foot deep pit in the soil. The face of the pit should be about 18" wide. Show i) type and thickness of litter, ii) thickness and colour of humus, iii) location of plant roots, iv) bases of surface vegetation and, v) any bands of different texture or colour. Use coloured pencils.




CHANGES IN VEGETATION ALONG TRANSECT
4
8
12
16
20
24
28
32
36
40
44
48
50 yards
AVERAGE HEIGHT
% COVER
NO. OF SPECIES
CANOPY
%GRASS
% TREES
100
50
0
KEY:
--- Grass
— Trees

DRYNESS
(COBALT CHLORIDE Sec.)
0 1 2 3 4 5
EXPOSURE TO WIND
(1 to 5)
0 1 2 3 4 5
LIGHT INTENSITY
(METER UNITS)
0 1 2 3 4 5
TEMPERATURE
(°C)
0 1 2 3 4 5
4 8 12 16 20 24 28 32 36 40 44 48 50
CHANGES IN WEATHER ALONG TRANSECT
KEY:
0' = ——
6' = - - - -


CHANGES IN PROPERTIES OF SOIL ALONG TRANSECT
4
8
12
16
20
24
28
32
36
40
44
48
50
PERCENTAGE LITTER
DEPTH OF HUMUS (")
pH
DRYNESS
100
50
0
KEY:
-1" = ---
-2' = ——

(c) Composition of Litter (Station I and III)

Fraction of Litter	Station I		Station III	
	% Volume	pH	% Volume	pH
Dead whole leaves				
Large leaf pieces				
Small leaf pieces				
Dark grains				

(d) Other Soil Studies

Collect jars of soil from each place. Back in the laboratory you may care to investigate factors such as i) hardness, ii) proportions of humus, clay, loam and sand, iii) water holding capacity, iv) moisture content, v) organic content, vi) amount of air in the soil and, vii) inorganic salts present. Suggest ways of investigating these and other factors. Draw up tables of your results.

Questions About the Environment

1. Describe the environment of Station I.

2. Describe the environment of Station III.

3. What are the differences between Station I and Station III?

4. In what ways do the layers of vegetation influence the weather at different heights in grass and timbered areas?

5. Which place has the most suitable environment for a widely varied population of plants?

6. Which station has the richest soil? What is your evidence?

7. Explain any difference in pH i) between stations
   ii) between surface and deeper layers of soil

8. Compare the soil at Stations I and III.

9. Can you say that any aspects of the environment have influenced any other aspects? If so, give some examples.

10. What do the graphs of temperature, moisture and light show with regard to the environment of vegetation changes from grass to trees?

Part III

Invertebrate Communities in the Litter and Herb Layers Amongst Grass and Amongst Trees

Collecting Methods

In areas typical of Station I and Station III collect invertebrate animals as follows:

(a) From Herb Layers

All members of the group collect for exactly 20 minutes, first at Station I and then at Station III by sweeping vegetation from 0 to 2' high with butterfly nets and by inspecting vegetation and collecting any invertebrates crawling on or flying between plants. Place all animals collected into killing bottles labelled Station I and Station III.

(b) From Litter Layers

All members of the group collect for exactly 20 minutes from the litter layers, first at Station I and then at Station III. Sort the litter by sweeping it aside with trowels or white card or fingers and pick up invertebrates with fingers or damp brush. Use forceps for dangerous animals such as centipedes, scorpions or large spiders. Place all animals directly in a tube of 70% alcohol. Label the tube Station I or Station III. Sample all likely habitats such as open litter, around and under stones and under and in rotting logs.

Sorting the Collection

On returning to the laboratory keep the animals in four separate collections - from trees (a) herb layer (b) litter layer and from grass (c) herb layer (d) litter layer.

Within each collection sort the animals in major types (snails, earthworms, beetles, grasshoppers, cockroaches, centipedes, etc.) and count the number of each type in the collection. Put the results in the tables provided.

Sorting is most easy by using white enamel dishes and by picking up the smaller animals with a fine brush. Place larger specimens such as grasshoppers dried onto white paper, and smaller specimens (usually from litter layers) in petri dishes of 70% alcohol.

Invertebrates of the Herb Layers in Grass and Tree Communities

Number of Collectors

Time spent collecting = 20 minutes in each community

Abundance scale	Very few =
	Few =
	Many =
	Very many =

HERB LAYERS

Animal Type	GRASS COMMUNITY (I)					TREE COMMUNITY (III)				
	No.	Very Few	Few	Many	Very Many	No.	Very Few	Few	Many	Very Many

Invertebrates of the Litter Layers in Grass and Tree Communities

Number of Collectors

Time spent collecting = 20 minutes in each community

Abundance scale	Very few =	
	Few =	
	Many =	
	Very many =	

LITTER LAYERS

Animal Type	GRASS COMMUNITY (I)					TREE COMMUNITY (III)				
	No.	Very Few	Few	Many	Very Many	No.	Very Few	Few	Many	Very Many

Invertebrate Populations in Grass and Tree Communities

(a) Numbers of Animals

Calculate the numbers of invertebrates in the collections (see previous tables) and enter them in the following table.

Grass		Tree	
Herb Layer	Litter Layer	Herb Layer	Litter Layer
Herb + Litter		Herb + Litter	
Grand Total (Grass + Tree)			

(b) Percentages

Calculate each figure in the previous table as a percentage of the grand total and enter in the following table.

Grass		Tree	
Herb Layer	Litter Layer	Herb Layer	Litter Layer
Herb + Litter		Herb + Litter	
Grand Total (Grass + Tree) 100%			

(c) Diversity

Count the number of animal types in each part of the collection and enter them in the following table.

Grass		Tree	
Herb Layer	Litter Layer	Herb Layer	Litter Layer
Herb + Litter		Herb + Litter	
Grand Total (Grass + Tree)			

Questions About the Animals

1. List down the four places studied in rank order on each of the following qualities

   i) number of animals
   ii) number of types of animals

2. Which place, grass area or tree area, had

   i) the most diverse population?
   ii) the greatest number of animals?

   Can you explain these results?

3. Which layer, herb or litter had

   i) the greatest variety?
   ii) the greatest numbers?

   Can you offer an explanation?

4. Which types of animals were most common

   i) in grass?
   ii) in the tree area?

Part IV

Adaptations of Animals and Plants

Study the collections of plants and animals and examine specimens for features that make them suited to the places where they live. Include simple drawings of plants or parts of plants and of the invertebrate animals.

(a) Adaptations of Plants

Specimen Number	Plant Type	Locations and Environmental Conditions Where Most Common	Adaptations		
			For Resisting Dryness	For Obtaining Energy	Other

(b) Adaptations of Common Animals

Specimen Number	Animal Type	Locations and Environmental Conditions Where Most Common	Adaptations	
			For Movement	For Resisting Dryness

Questions About the Adaptations

1. List some of the adaptations of plants growing amongst trees for getting maximum energy.

2. Describe some of the adaptations of grasses for survival under dry conditions.

3. List some of the adaptations of animals living in the drier places for conserving water.

4. Describe some of the adaptations of animals from the litter layer that enable them to move quickly and easily between the layers of litter.

5. Choose one animal very common in grass and one animal very common in the tree zone. Compare and contrast the ways of life and the adaptations of the two animals.

6. Choose one i) epiphyte, ii) climber, iii) shrub and iv) herb. Show how differences between the shoots of these plants can be related to the places where they live.

Conclusion

What can you now conclude about our hypotheses?

Fill in the following table, ruling off each hypothesis in turn.

Hypothesis Number	Has it been verified Yes or No	If No how should the original hypothesis be modified?	What evidence do we have for this conclusion?

Answer the following questions.

1. Have we been able to show any causes and effects? If so give some examples.

2. As the environmental conditions changed from grassland to timber we noticed changes in the plant types. Is it possible, with our present data, to decide if the environment caused change in the vegetation or the vegetation caused change in the environment?

   Discuss this problem considering factors such as light, temperature, moisture and soil.

3. Design an experiment to show whether grass type I grows best under hot, bright conditions or under cool, dark conditions.

4. Try to explain from <u>all</u> the information we have why the grassy area is not timbered and why the area of trees is not a grass community. (This is a difficult question and it may not be possible to find a clear cut explanation).